97-84023-6

Presidents' Conference Committee (U.S.)

Suggestions for carrier's consideration in...

Philadelphia

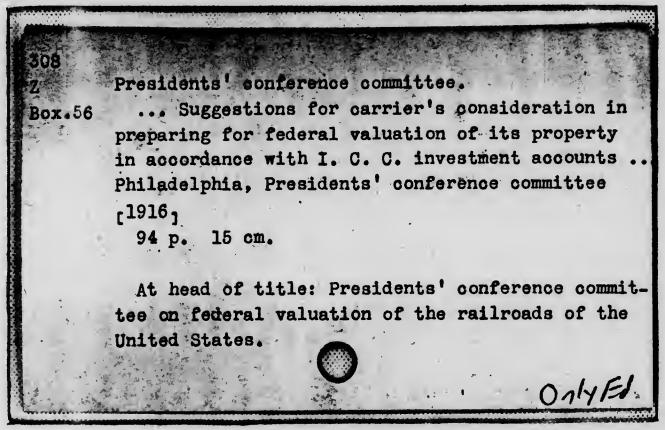
[1916]

97-84023-6
MASTER NEGATIVE #

COLUMBIA UNIVERSITY LIBRARIES
PRESERVATION DIVISION

BIBLIOGRAPHIC MICROFORM TARGET

ORIGINAL MATERIAL AS FILMED - EXISTING BIBLIOGRAPHIC RECORD



308
Z
Box.56

Presidents' conference committee.
... Suggestions for carrier's consideration in preparing for federal valuation of its property in accordance with I. C. C. investment accounts .. Philadelphia, Presidents' conference committee [1916]
94 p. 15 cm.

At head of title: Presidents' conference committee on federal valuation of the railroads of the United States.

Only Ed.

RESTRICTIONS ON USE: *Reproductions may not be made without permission from Columbia University Libraries.*

TECHNICAL MICROFORM DATA

FILM SIZE: 35mm REDUCTION RATIO: 9:1 IMAGE PLACEMENT: IA (IIA) IB IIB

DATE FILMED: 2-12-97 INITIALS: MS

TRACKING # : 21301

FILMED BY PRESERVATION RESOURCES, BETHLEHEM, PA.

Prof. E. R. A. Seligman

308
Z
B6X56

SUGGESTIONS FOR CARRIER'S CONSIDERATION IN PREPARING FOR FEDERAL VALUATION OF ITS PROPERTY IN ACCORDANCE WITH I. C. C. INVESTMENT ACCOUNTS

FIRST ISSUE SEPTEMBER 25, 1916

OFFICE OF
GENERAL SECRETARY
PRESIDENTS' CONFERENCE COMMITTEE
PHILADELPHIA, PA.

308
2 BOX 56

PRESIDENTS' CONFERENCE COMMITTEE
ON
FEDERAL VALUATION OF THE
RAILROADS OF THE UNITED STATES

SUGGESTIONS FOR CARRIER'S CONSIDERATION IN PREPARING FOR FEDERAL VALUATION OF ITS PROPERTY IN ACCORDANCE WITH I. C. C. INVESTMENT ACCOUNTS

FIRST ISSUE SEPTEMBER 25, 1916

Carriers are requested to send to the General Secretary, criticisms and suggestions with reference to any of the matter contained herein.

OFFICE OF
GENERAL SECRETARY
PRESIDENTS' CONFERENCE COMMITTEE
PHILADELPHIA, PA.

TABLE OF CONTENTS.

I. C. C. Acct. No.		Page
1.	Engineering	3
2.	Land for transportation purposes	3–6
3.	Grading	6–18
5.	Tunnels	18–24
6.	Bridges, trestles and culverts	24–28
8.	Ties	28–29
9.	Rails	29–30
10.	Other track material	30–31
11.	Ballast	31–34
12.	Track-laying and surfacing	34–36
13.	Right of way fence	36–38
14.	Snow and sand fences and snow sheds	38
15.	Crossings and signs	38–41
16.	Station and office buildings	41–46
17.	Roadway buildings	46
18.	Water stations	46–62
19.	Fuel stations	62–65
20.	Shops and engine houses	65–67
21.	Grain elevators	67–68
22.	Storage warehouses	68
23.	Wharves and docks	68–69
24.	Coal and ore wharves	69–70
25.	Gas producing plants	70–71
26.	Telegraph and telephone lines	71–74
27.	Signals and interlockers	74–77
28.	Power dams, canals and pipe lines	77–78
29.	Power plant buildings	78–79
30.	Power substation buildings	79
31.	Power transmission systems	80
32.	Power distribution systems	80–81
33.	Power line poles and fixtures	81–82
34.	Underground conduits	82
35.	Miscellaneous structures	82
36.	Paving	82–84
37.	Roadway machines	84–85
38.	Roadway small tools	85–86
39.	Assessments for public improvements	86–87
40.	Revenues and operating expenses during construction	87–88
41.	Cost of road purchased	88
42.	Reconstruction of road purchased	88
43.	Other expenditures—road	88–89
44.	Shop machinery	89–92
45.	Power plant machinery	92–93
46.	Power substation apparatus	93
	Concluding remarks	93–94

SUGGESTIONS FOR CARRIER'S CONSIDERATION IN PREPARING FOR FEDERAL VALUATION OF ITS PROPERTY CLASSIFIED IN ACCORDANCE WITH I. C. C. INVESTMENT ACCOUNTS.

ENGINEERING.
(I. C. C. ACCOUNT No. 1.)

Engineering costs in connection with any work being inspected can be determined only from examination and study of the carrier's records, or records of similar work done by other carriers. Attention should be directed by the carrier's engineer to any excess costs of engineering in connection with any line or portion thereof under inspection, due to conditions attendant on, preparation for, and prosecution of the construction, such as numerous reconnaissance trips and preliminary and location surveys before a suitable final location is secured, such as a country that is very difficult to traverse and which affords no sustenance to men, prolonged periods of severe weather conditions, difficulty in gaining access to line and difficult construction work which would extend time of construction, the closing down of construction work for winter months, and its resumption during summer, heavy charges for designing and other assistance in chief engineer's office, etc.

LAND FOR TRANSPORTATION PURPOSES.
(I. C. C. ACCOUNT No. 2.)

The carrier's engineer should be provided with a map, for use of himself and pilot, showing all of the carrier's land used as right of way and all of its land contiguous thereto. Where fences, monuments, or other evidence of right of way limits or of land lines are not readily seen or do not exist, the carrier's engineer should be sufficiently familiar with conditions and locations to be enabled to assist the Government

engineer in checking satisfactorily the data shown on the right-of-way map. Information should be procured and attention should be directed thereto, showing the location, area and general character of all of the carrier's lands not contiguous to the right of way, and as to the railway purposes, if any, for which such lands are used. Lands used as location for office buildings, tie forests, ice ponds, gravel pits, etc., are representative of this class.

Among many items in connection with lands owned or used that should be investigated, are the following:

Lands acquired and used as locations for changes of channels of streams, and as locations for dikes, levees, snow or sand fences and other protective construction in connection with roadbed or bridges.

Right of way for temporary tracks for carrying traffic or transporting construction material during any construction work.

Right of way for pipe lines.

Land acquired to provide sources of water supply and to protect sources from contamination by live stock.

Location of borrow pits or of waste banks on land not purchased.

Lands temporarily used during construction as sites for material yards, for temporary highways, for camping grounds, and for roads to permit ingress to and egress from the location of the work.

Land acquired and used for highway purposes; such as land for a new highway location because of appropriation of old highway location by the carrier, such as land acquired and dedicated to public use for highway purposes in order that a change may be made in the location of a highway crossing to permit it to be under or over grade, and such as extra land as a site for the construction of approaches to, over or under grade highway crossings.

Right of way for ditches used to drain land prior to or during construction or for permanent drainage schemes.

Right of way or permits for construction of sewers from shops or from other facilities.

Rights that permit the construction of tunnels, without giving any title to or interest in the surface.

Riparian rights secured without obtaining any other interest in or title to the land to which the riparian rights normally would pertain.

Water supply and water power rights that cannot be detached from land, necessitating the holding of title to land.

Surface or support rights in connection with lands located in mining or oil fields.

Rights to the use of land for the support of the roadway through sections that are practically inaccessible to a railroad on another location, such as canyon rights.

Land acquired for wharves and docks and the riparian rights necessary therefor.

Cases where construction of under or over grade crossings, of city viaducts, of high fills or deep cuts, or of any other construction objectionable to adjacent property owners has necessitated payments to liquidate damages to abutting property, or the acquirement of the property.

Land used in connection with lines that have been abandoned because of changes or revisions—both land used as right of way and lands not contiguous thereto. The disposition of lands on abandoned lines should be determined, considering whether sold, relinquished to original owner, or still held by the carrier.

Lands granted by franchises and ordinances in cities; streets and alleys vacated in favor of the carrier. In this connection should be noted all struc-

tures built or improvements made by the carrier in return for franchises granted or streets and alleys vacated, such as grading lots, excavating channels, building subways, viaducts, retaining walls, sidewalks, sewers, etc.

Consideration other than money paid for lands, which does not appear in connection with the right of way, such as the reconstruction of irrigation ditches, the drilling of new wells, the construction of drainage ditches, the moving and repairing of buildings, etc.

Buildings or other structures and improvements that have been moved, torn down or destroyed, to permit railroad construction to be accomplished, and which now may not be evident as elements of value in connection with land acquired.

Land crossed by the right of way and other land owned or used should be noted as to character affecting its value for general purposes, such as wooded, swampy, cultivated, etc.

GRADING.
(I. C. C. ACCOUNT No. 3.)

In order to determine quantities involved it is contemplated by the Commission that its engineers shall cross-section all roadbeds.

Where it is obtainable from records, the carrier's engineer should be provided with information as to actual grading quantities that were paid for in the construction of the railroad. He should have a profile showing ground line and subgrade of the railroad and should guard against taking original grading quantities as final where additions have since been made. He should know whether the profile is made from levels taken on the center line of single track, on center line between double tracks, at toes of slopes, or on other base line.

The standard width of roadbed used in the construction and the requirements of the grading specifications used should be known.

The contract under which work was done should be referred to and the terms thereof noted, especially those clauses defining the force to be used, the time limit, bonuses or forfeits, and transportation or other facilities to be furnished free or at reduced rate to the contractor. Force account work should never be converted into yardage.

Clearing and grubbing quantities should be obtained from records where possible. Where records are not accessible, other sources should be resorted to for obtaining information relative to the amount and character of timber on the right of way at the time of construction of the road, and relative to the probable original quantity of clearing and grubbing required; this data should be furnished to the Commission's representatives as constituting a claim of the carrier. Observation as to timber on adjacent land may be helpful. The specifications showing how much grubbing was required under fills should be inspected.

Classification of grading quantities should be made under the carrier's standard specifications that were used in the construction of the road. Where the lines of demarcation in excavation, between different kinds of material, are not plainly defined, and the present apparently correct classification does not check record quantities and classification, trenching should be resorted to in an effort to secure proper classification and determination of quantities. Where record quantities are not available as a check, a careful examination should be made of all excavations where rock is thought to exist. Rock strata in excavations are frequently covered, soon after construction,

with earth washed down from superimposed strata. Materials originally classified as brule clay, shaly limestone, shales, sandstone, hardpan, soon weather after exposure and soften so that the nature of the original material is difficult of determination, and they may now appear as earth. Where embankments have been constructed wholly or largely of material secured from excavations not on center line of the railroad, an examination of the embankments, as well as of the borrow pits, should be made for evidences of classified material that has been borrowed.

Many excavations now dry and perfectly drained may have been wet and may have contained springs, when originally made, and the work connected with them may therefore have been expensive to handle, calling for a higher unit price than present appearances would indicate. Wet excavation in channel changes, drainage ditches, and levee construction should be noted.

Materials exceptionally employed in raising track under traffic, such as ballast, cinders, etc., should be sought. Materials of a special nature employed to prevent the formation of water pockets in the widening or raising of grades, should also be sought, as should material originally applied as ballast, which has settled below subgrade, thus increasing the supporting capacity of the roadbed.

Overhaul of material should be investigated, and where possible notes should be made as to the manner in which material was actually handled. All long or excessive hauls of material from excavations on the center line or from borrow pits should be noted, so that the quantities will reflect the actual expense of handling such work.

Excess Quantities outside of normal roadbed should be thoroughly searched for and noted. Among many items that should be considered are the following:

Old borrow pits filled and waste banks moved during the construction of additional tracks, changes of line or of other facilities. Excavations for previous construction that have been filled, and any embankments for previous construction that have been incorporated in new work.

Special provision for taking care of sewers, water and gas mains, etc., where the railroad was projected after construction of sewers, etc.

Hills graded entirely away, and low spots and sink holes filled. Such conditions are often found along the foot of hills or cliffs, and also in the vicinity of stations, large yards and terminals. In yards and terminals extensive grading work has sometimes been done over large areas where the present appearance of the ground would give little evidence of such work. If other readily-applied methods of investigation do not bring forth satisfactory information, test pits or borings at regular intervals should be resorted to, for the purpose of finding the depth and character of the embankments.

Slides and overhanging rocks that have been removed from lines along the foot of steep hills or cliffs.

The use of stringers on the ground under the ties or of trestles to support tracks along water fronts and other similar places, where the soil is not suitable for supporting tracks unaided.

Excess quantities due to subsidence generally and to sunken embankments, resulting from construction on unstable material in swamps and along banks of streams. In swamps or in shallow lakes any considerable settlement of an embankment is often accompanied by a corresponding upheaval of the ground surface on one or both sides of the embankment. Such upheaval sometimes is soon weathered or washed away,

so as to give little evidence of actual conditions, but in places where sunken embankments may exist, indications should be sought on the ground.

Reports as to tests by borings on various roads may be inspected at the Group headquarters.

Special construction used in building railroads over swamps or marshy ground. Corduroy base is often constructed, material from a distance is often hauled in for making the roadbed, and material is sometimes removed and replaced by more suitable material. Work done to provide drainage of the swampy land before construction work was started should be investigated.

The extent and size of borrow pits should be observed, and any extra width in cuts in the vicinity of such places should be inspected for evidence of excess material which may have been removed and placed in the embankments. Train service for transporting cinders or other material may have been used. Records should be searched for information as to any such excess quantities and costs.

Excess quantities in embankments along banks of streams where material underlying them has been washed out by floods, thus causing settlement of the embankments. Maintenance-of-way employees may have information of value in such cases.

Quantities involved where cuts along the sides or the foot of hills or cliffs have been daylighted. Where old or original profiles are accessible to show the ground line on the original center line they will be of use in determining quantities. An examination of the cliffs or slopes adjacent to the roadbed may disclose whether or not they have been changed. The projection of the ground line on each side of the roadway may indicate the probable former ground line across the roadway.

High embankments, as they are usually a source of trouble to the railroad at some time in their history, should be investigated for information as to excess

quantities. Records may show that train service was employed and that ballast, cinders, etc., from terminal points, or other material, has been deposited for use in keeping track up to normal grade.

Abandoned mine workings that require special treatment. Subsidence of the surface due to caving in of the workings often requires excess quantities to be put on roadbed to preserve it in normal condition. Such conditions should be investigated in all localities where mines have been or are being worked. Where line changes, revisions of alignment, or other constructions are undertaken in such localities, it is often necessary to fill in the abandoned rooms and entries, to protect the construction on the surface above them.

Excavation for the conversion of tunnels into open cuts. The reasons for original tunnel construction, the difficulties of maintenance of the tunnel, and the reasons for conversion of it into an open cut, with description of conditions encountered in prosecuting the conversion work, should be investigated.

Filling of openings spanned by bridges, trestles and culverts after the road was in operation. The kind of material used, the source from which it was obtained, the manner of loading and unloading material, and other conditions that were encountered during progress of the work should be noted.

The use of temporary trestles in the construction of high embankments; such trestles are often constructed sufficiently strong to permit their use in carrying traffic for some time after the road is in operation, if the embankments are unstable.

Ravines that have been filled in, on the higher side of the railroad, for considerable depth, to permit the use of shorter culverts than otherwise under the embankment, when it was deemed inexpedient to divert water from the natural channel by ditches to the proposed shorter culverts.

Approaches to grade crossings and to overgrade and undergrade crossings of highways and the railroad, where all or part of the cost has been borne by the railroad, and the grading is not readily seen to be a part of the railroad construction.

Changes in the grade of streets preparatory to the construction of viaducts, and quantities involved in raising or lowering streets to obtain greater clearance or for other reasons, and damages to abutting property resulting therefrom.

Quantities involved in the construction of highways, either on or off the right of way, such as quantities in highways for temporary use during construction, and such as quantities in new highways required because of the appropriation of the old highway location by the railroad, and such as quantities in highways projected in new locations to permit the construction and use of undergrade or overgrade crossings of the railroad and the highways.

Changes in channels of streams, and the construction of levees, dikes or ditches, either on or off the right of way.

Grading for temporary tracks that are required to take care of traffic during the prosecution of construction work for accomplishing line changes, revisions of alignment or grade, channel diversions, or other changes and improvements.

False bermes constructed as a protection to embankments.

Hand car turnouts, rail rests, etc.

Excess material removed from the bottom of wet cuts to permit the establishment of a firmer foundation for the roadbed, and quantities of other more stable material hauled in to replace it.

Material removed from below subgrade in rock cuts and cushion material used to replace it.

Reconstruction of ditches for irrigation purposes, because of appropriation of old ditch locations by the railroad.

Grading done in return for franchises that have been granted, or for the use of streets that have been permitted, such as the grading of lots and streets, the excavation of channels, etc.

Protection of Roadway secured by any form of construction work, or any expense or care used to enlist and direct the aid of natural forces should be noted.

Among the many kinds of protection that may be used are the following:

Construction on steep hillsides to keep embankments from sliding, such as masonry or timber retaining walls, piling driven in embankments, and slopes built up of selected stone.

Retaining walls in connection with elevated or depressed tracks in cities.

Sodded slopes, cultivated weeds or other rank vegetable growths on slopes; trees and bushes at foot of or on the slopes; terraces; brush embedded in slopes; old trees or other timbers staked on slopes, ditches along excavation slopes; all to prevent or minimize the damage that would result from wash.

Construction to secure sub-drainage, such as drain tile in cuts and in embankments. The location, size, length and the depth at which laid should be ascertained for each string of drain tile; similar information should be obtained for all cross drains. Complete information as to tile drains cannot always be secured from inspection, and searching of records, and inquiries from employees must be resorted to. Tile in embankments should be the subject of special inquiry.

Tile drains or other construction to carry water away from roadbeds, when it comes from springs in cuts or under embankments.

Special application of material, such as corduroy, rock, etc., in cuts or other soft places in the roadbed, to keep ballast from sinking and to provide a more stable roadbed.

Blind drains constructed of rock or timber, to take care of drainage where culverts are not required.

Riprap, retaining walls, cribbing dams, bulkheads, mattresses, levees, dikes, jetties, and other construction to protect the roadway from damage by reason of high water washing away embankments or carrying foreign material on the roadway. Repeated applications of riprap may have been made at certain exposed points without any of it now being visible, because of earth that may have washed over it, because of bank-widening material placed on it, or because of vegetation covering it. Second or other additional track construction may have covered up protective work applied to the original line. Some such construction is often placed along the banks of streams to prevent any erosion of river banks that might endanger the roadway. Search should be made for such items wherever streams are near the roadbed. Protective work on large or navigable streams is often paid for wholly or in part by the Government, and the cost, if any, of such work to the carrier should be ascertained. Levees and dikes are often constructed as a protection against high water in swamps. Such construction is often outside of right-of-way limits. In many cases the railroad has built extensive bank protection some distance up stream from the railroad crossing.

Surface ditches along the top of excavations and along the foot of embankments and drainage ditches constructed in swampy country or in regions subject to overflow to protect the roadway. These may be outside of right of way. Such ditch work may be part of a general drainage scheme inaugurated by counties or by other drainage districts, the cost of it being taken care

of by general assessments levied against those benefited. Investigation should be made by inquiry and by the searching of records to disclose fully the attendant conditions.

Changes in channels of streams for preventing overflow and consequent damage to embankments, or for lessening number of openings where roadways would be endangered. Evidence should be sought as to pipe box or arch culverts or bridge piers that have been filled in or covered over, after the accomplishment of changes in channels. Such changes are often made outside of right of way limits. Evidences of the construction work are sometimes not readily noted a few years after completion. The location, extent and character of the work done should be noted, and information should be procured to show whether it was paid for wholly or in part by the carrier.

Landscape gardening, and all work done and expense incurred in preparing locations and in planting trees, flowers, shrubs, lawns, etc., either as protective measures or for beautifying grounds, should be investigated.

The examination of records covering flood expenses and the construction of special protective work from time to time should disclose many items.

Special conditions encountered during construction and methods employed in handling work should receive consideration. Among the numerous items to be investigated are the following:

Excavation of cuts and construction of embankments narrower than standard widths and on temporary grade line, to permit the laying of track and the subsequent completion of grading work by the use of trains, steam shovels, etc., Note should be made as to whether completion of narrow cuts and fills to standard width and final grade was done by contractor or by railroad forces.

The use of trestles from which to dump material in constructing embankments, and the amount and source

of supply of trestle material. Where temporary trestles are so used, it should be noted whether it is permitted that they may be constructed at or above subgrade, or is required that they shall be built below subgrade so that deck material must be removed, and the top of the embankment made by raising the track to subgrade with material that is dumped from it.

Grade revisions where very slight, or where no changes in alignment were made. Complete information should be obtained, so that quantities may be returned that will reflect the actual cost of such work. The quantities involved in the original work and the additional quantities in the revised work should be secured and the methods of construction ascertained. Where subgrade is raised, the material may be deposited by teams or by trains, or partly by each. Where raising of track was done under traffic, the cost to the carrier of such raising should be ascertained, in addition to the cost of securing and depositing the material at the site of the revision. The lowering of subgrade, with its usual attendant high costs, should receive special attention. The approximate amount of traffic over the road; the source from which material is secured; the nature of the material and the manner of depositing it; the kind, quality and condition of the track material; and the weather conditions, all have a bearing on the cost of handling grade revision work under traffic.

Prosecution of construction work adjacent to operated lines, where unusual care was required to protect traffic; such care is required in removing rock and other material that requires blasting.

The protection of adjacent buildings and the safeguarding of the public during construction.

The protection of telegraph, telephone and signal wire service by use of cables on the ground during prosecution of adjacent construction; the construction of temporary wire lines outside of the danger zone.

Employment of special watchmen, flagmen, switch tenders, signalmen, etc., during construction adjacent to operated lines of railroad.

Weather conditions under which work was prosecuted.

The excavation and handling of frozen material.

Work done at night in hastening completion of work.

Bonuses actually paid to, and forfeits actually collected from, contractors.

The force and equipment actually used on the work.

The length of time required to complete work.

Floods and washouts; land and snow slides; wrecks; injuries to persons; epidemics; fires; devastating storms, etc., during construction.

Equipment damages, destroyed or lost during construction.

Facilities supplied free or at reduced rates to the contractor, such as transportation for machinery, outfits, equipment, tools, food and supplies and men; and such as rail and ties for temporary tracks; track material for use in transporting grading material; tools and equipment; water and fuel, etc.

The character of the country; whether settled or wild; whether mountainous, hilly or plains; whether difficult or easy of access; whether affording full or no sustenance to men and animals; whether supplied with good, poor, or no wagon roads, etc.

The close proximity of a parallel railroad line, which affords easy access to the vicinity of the road under construction.

The location of the labor market and the market for supplies.

The requirements as to dressing of slopes.

The securing of material from borrow pits, and the wasting of excess material, on land not belonging to the carrier.

Special difficulties in excavating wet cuts and in making fills on wet ground or in water.

Conditions attendant on elevating or depressing tracks in cities, with resulting damages to abutting property.

The purchase and use of grading outfits and tools by the carrier.

TUNNELS.

(I. C. C. ACCOUNT No. 5.)

Tunnel construction often presents difficulties of great variety and magnitude, and it is important that special attention should be given to the search for data relating thereto.

All Plans relating to the tunnel and shaft sections; to the lining, invert, portals; or to any special part of the construction should be referred to, and copies of them should be at hand for use, if they are needed to make the general condition clear.

The Contract under which any of the tunnel or auxiliary construction may have been prosecuted should be referred to and its special terms noted, particularly those referring to the time limit, the force, and the kind and amount of equipment which was employed; bonuses or forfeits, liability in case of accidents, facilities to be furnished to the contractor free or at reduced rates, etc. The specifications applying to the construction work should be inspected. Where all or portions of the work was done by the carrier's forces, the limits of such work should be determined, and it should be clearly distinguished from contract work.

Preliminary Work previous to starting of construction, such as extended surveys, and the sinking of drill holes or of trial shafts, etc., should be noted.

The Material removed from the tunnel section, or from any auxiliary excavations, should be classified

under the specifications used during construction. Where lining prevents inspection of material in the tunnel, the adjacent embankments, waste banks, and all records should be inspected for information. Records and inquiry only can be made use of in determining quantities of wet excavation that were handled. The amount of overhaul required to accomplish disposal of the excavated material should be determined; if trestles were required from which to dump material to form the railroad embankments, or to deposit it in waste banks, the conditions should be made clear.

The quantities removed and paid for as breakage outside of the net tunnel or shaft sections should be determined, as should the kind, amount and manner of depositing of material used for packing back of tunnel and shaft linings. Back filling around portal construction should also be considered.

The Tunnel Section and its evolution, which should be considered as to whether for single track or for two or more tracks; whether constructed as a twin tunnel on the same grade line or elevation as the first tunnel, or on a different one; whether constructed with a small section and later enlarged or constructed new, with its present section; whether constructed large enough to admit of future lining, or small so that enlargement for admitting of later lining was necessary, has a bearing on the cost of the tunnel.

Special Conditions encountered and methods employed in prosecuting the work should be noted.

Among the many items to be considered are the following:

Unstable material that necessitated shoring, bracing, and the immediate construction of lining.

Water encountered, as lakes, flowing streams or springs in such quantities that it interfered with progress of work and necessitated special construction,

and in some cases may even have caused the abandonment of the project in that particular location. Water of high temperature may present special difficulties.

Where water was encountered the possible use of caissons or cofferdams in connection with putting in foundation for portals, in preparing the floor of the tunnel for carrying track, and in excavating shafts or adits, should be investigated. The use of pumping plants for removing water from tunnels and from shafts and the use of temporary ditches or drains may be required. The installation of permanent pumping plants in the tunnel should be noted, and search should be made for evidences of pipe lines, tile drains, ditches and other drainage facilities installed for permanent use.

The presence of water in tunnels may necessitate the use of special construction for carrying track, such as piling and stringers, or steel girders with their necessary supports; such construction should be fully investigated and described.

The presence of gas in such kind and quantity that the risks were increased, and special precautions were required. Special construction or the installation and use of special equipment may have been resorted to in securing necessary ventilation. The reasons for, the costs of, and the conditions attendant on, the installation of a permanent ventilating system should be ascertained. Where power is required for forcing air through tunnels, the power plant may be used to supply water for other purposes.

Rock material of varying hardness, fissured rock and rock with inclined strata, which increases the difficulties of drilling.

Accidents, such as explosions of gas, the caving in of roofs, the falling of rocks, premature blasts, slides, wrecks, etc., resulting in injuries to persons or loss of life; in loss of, or damage to, equipment; and in delays.

Costly revision or adjustment work, made necessary on account of errors in grade or alignment, where tunnels have been constructed simultaneously from each end.

The construction of shafts and adits at frequent intervals, for use during the progress of the tunnel work; in order to hasten its completion or for ventilating purposes, and which may have been sealed up after completion of tunnel. The methods used in shaft sinking should be ascertained, giving consideration to the kind and amount of lining applied and to the manner of applying it, such as by underpinning or by constructing it on the surface and then undermining and sinking it.

Lighting plants which may have been required by special construction conditions. Where permanent lighting systems are installed the reasons for, the costs of, and conditions attendant on, the construction should be determined, and a general description should be secured. Power for lighting purposes may be supplied from a power plant that also serves other purposes.

The construction, with attendant quantities and costs, of switchbacks or shooflies, in order to enable operation of the railroad in advance of the completion of tunnels; or in order to reduce the cost of construction by providing a means of transporting material to other construction work in progress.

Special portal construction; the depth of the foundations, the kind and amount of material excavated, the dimensions and character of the footing, and the kind, amount and source of supply of the material in the portals, should be ascertained.

Piling under footings; paving about the portals; special provisions for drainage; and special construction to prevent slides from choking up the mouth of the tunnel are sometimes required.

The time consumed; the force employed; the kind and amount of equipment used; the facilities furnished free or at reduced rates to the contractor; the nature of the country; the accessibility of the work from towns on railroads; the location of the market for laborers and supplies, etc., should be ascertained.

Work Done Under Traffic in connection with tunnels; such as the enlargement, the lining, or the relining of the tunnel section, and the installation of special invert construction, is usually accomplished only at great expense. Where work of such character has been done special care should be observed in assembling information that will show all the quantities involved in, and the various conditions attendant on, the prosecution of the work. After getting all the information as to conditions and cost, make the many modifications that the program of reproduction might necessitate.

Some of the factors that affect the cost are:

The proximity of side tracks to the tunnel, for the convenient use of work trains, and the amount of work-train service required.

The length, alignment, and gradient of the tunnel; the location of shafts and the direction of prevailing winds, which may have a bearing on the time required to clear the tunnel of smoke after the passage of trains, so that men could work safely. Ventilating systems may have been installed for temporary use during construction. Where ventilation is poor the time consumed is increased, the safety of the laborers is endangered, and accidents are of more frequent occurrence.

The amount of clear space in the tunnel in which to work.

The stability or instability of the material in the bottom, sides and roof of the tunnel.

The character, condition and amount of any old lining that was removed, and methods adopted for removing it.

The character and thickness of lining and of invert material applied; the quality of brick and of stone; the proportions of material used in concrete; the kind and amount of any reinforcing steel used; the kind and dimensions of timber; the weight of hardware used; and the source of supply of any and all material used, should be ascertained.

The use of a temporary lighting system and a telephone system for facilitating the work and protecting laborers.

Methods available, and made use of, for transporting material into the tunnel.

The character and amount of tunnel material that must have been moved in enlarging the section, or in arranging for invert construction, and methods adopted for transportation and disposition of it.

Methods used to support track during invert construction.

The installation of a special signal system and the employment of extra telegraph operators, extra flagmen, etc.

The time required to complete the work; the force employed; the kind and amount of equipment used; the location of the normal labor market; the expense incurred for rental and repair of equipment used by the carrier's forces, etc., should be ascertained.

Transmission Lines, Signals and Irrigation Canals, when found in tunnels, should be noted, and conditions attendant on their installation should be described.

Tunnels that have been Converted into Open Cuts should be considered and described in the same manner as tunnels still in existence. Information as to the rea-

sons for the original construction of the tunnel, as to the difficulties of maintaining it, and as to the reasons for converting it into an open cut should be sought.

In General the history of the maintenance work required in connection with the tunnel should be sought, as being of value in disclosing hidden quantities and special items.

BRIDGES, TRESTLES AND CULVERTS.
(I. C. C. ACCOUNT No. 6.)

Plans should be studied, and copies of standard plans and of any special plans that were used should be obtained, and reference should be made to the governing plan number in connection with each bridge, trestle and culvert. Any great deviations in the character or amount of the construction accomplished, from the work indicated on governing plan should be noted when discovered in field or office, so that attention can be directed to it. The date the structure was built or rebuilt under such plan should be ascertained. Where plans under which structures were built are not available, suitable investigation should be made to determine facts as to quantities of masonry and other parts of structures.

Materials that were used should be noted, giving consideration to the kind and quality of timber, stone, brick, concrete, and any other material used, together with the source of supply of the material and information as to whether furnished by contractor or by carrier should be ascertained. Reference should be obtained to the specifications under which steel was furnished for large bridges, to the load capacity, and also to concrete specifications showing proportions of the various materials used. The use of treated timber in trestles should be noted, with information as to the kind of treatment, and where and by whom applied. The weights of material should be known,

especially weights of units, such as wrought and cast iron used on wood trestles, in order to facilitate the work of inventorying and describing.

Special Preliminary and Construction Costs should be fully investigated, and records should be searched for information as to any preliminary expenses connected with bridge construction, such as extensive surveys, gauging of stream flow, borings and other foundation tests, and preliminary channel changes.

Information should be obtained as to whether work was done by carrier's forces or by contractor's forces; and the terms of any contract governing the work should be noted. The time consumed, the force employed, the equipment used, methods employed, accessibility of the work from railroad towns, facilities furnished free or at reduced rates to any contractor, etc., should be considered. Information should be sought as to any special difficulties encountered or costs incurred, noting conditions and costs where caissons or cofferdams were used; where special erection conditions were overcome because of deep, wide or swift streams; and noting any necessity for using barges; the dredging for foundations; the dredging channels in navigable waterways; the deflection of streams during construction by use of temporary dams, deflectors or flumes; the installation and use of pumping equipment; interference with work by floods, washouts and slides; the loss or destruction of, or damage to, construction equipment; the construction of telephone lines; foundation excavation in material difficult to handle; long or difficult team haul over poor roads; wild unsettled country which would not afford sustenance, etc.

Where erection or rebuilding was accomplished under traffic, the attendant conditions and the special costs should be ascertained fully. The raising of bridges and trestles under traffic, because of grade revisions,

is expensive, and should be investigated. Extra watchmen, signalmen, etc., may have been required on such work.

Records should be searched to ascertain information as to the amount of reinforcing steel in reinforced concrete; the amount and cost of waterproofing; the character and cost of drain protection; the use of piling or special foundations under pipe or small culverts in soft ground; the amount and cost of false work used in erection; the use of temporary trestles; the cost of providing openings in embankments where none had before existed; special construction and the costs thereof, to take care of water, gas and sewer pipes encountered in constructing piers and abutments in cities, the amount and character of paving on viaducts, etc.

Culverts may now be constructed and covered over, or solid embankments may have been built, where trestles or bridges formerly were constructed.

Bridges may, in some instances, have been raised or lowered to obtain greater clearance from highways or other railroads.

The lowering of the footings and the enlargement of piers or abutments under viaducts over tracks, or removal and reconstruction of them, because of extension of the viaduct, may be occasioned by the widening of cuts or by other work done to provide more room for tracks.

Foundations should receive special consideration, as to depth and as to the quantities and classification of material excavated from foundation pits; as to the kind and dimensions of footings; as to the use of piling in the foundation and the use of grillage or cribbing. The penetration of piling used in masonry foundations and the penetration of that used in trestles, should be investigated. The excavation required for culverts and small structures which may be readily overlooked, should be noted.

Bridge Protection, in its various forms, may occasion a considerable part of the cost of bridge work, and should be carefully investigated.

The quantities and costs of channel changes, ice breakers, riprap, curtain walls, paving, and of any other special protection to structures against scouring, ice gorges and floating debris, should be ascertained.

Search should be made for some distance up stream from bridges for jetties, riprap, mat work, protection walls, booms, wing dams, dikes, levees, and other methods of shore protection, and the cost of special work should be ascertained.

The Basis of Ownership, maintenance and use of all structures that are used by more than one carrier should be known. Similar information should be obtained relating to flumes carrying water under tracks for irrigation and power purposes. Any special maintenance expenses occurring because of unusual conditions should be explained.

Data similar to that outlined above should be secured in connection with all highway bridges and viaducts and their approaches in the construction or maintenance of which the carrier has participated; such bridges may not be over tracks, and all culverts or bridges, either on or off the right of way, that have caused expenditures by the carrier, either for construction or maintenance should be included.

Special Conditions such as the unsuspected location and the unusual type of structures may make some items obscure.

In large yards and terminals and in cities where the right of way is fully occupied, drains, pipe and other small culverts, are often constructed and covered and provided with connections, so that they are not readily visible.

Culverts under tracks, or strings of pipe alongside of tracks, which have only manhole openings and which connect directly with city storm water sewers, should not be overlooked.

Trestles or bridges for use of highways during construction of the railroad should be considered, as should new structures constructed by reason of the railroad appropriating old highway location.

TIES.

(I. C. C. ACCOUNT No. 8.)

The records should be searched for such information as to ties as will enable the railroad engineer to furnish to the Government engineer all the information that may be required to show the kind and character of the ties and the points from which they were procured.

A knowledge of the specifications under which all ties were produced, and information as to whether produced by the carrier's or by contractor's forces, should be secured.

The kind of timber in ties, the standard sizes of ties, the average weight each of cross-tie and the average weight per M. B. M. of bridge and switch ties, the standard number of cross-ties per mile, and the feet B. M. per standard set of switch ties for various turnouts used, should be known.

Special attention should be given to determining whether or not the ties are treated; if they are treated it should be ascertained whether they were purchased treated or untreated, where and by whom they were treated, and the kind and amount of treatment applied.

The date when ties were furnished to the carrier and the date laid in the track should be ascertained, as having relation to the age of the ties. Note should be made of large recent renewals, necessitated by

the relaying of rail, by ballasting, by the application of screw spikes, by the raising of track under traffic during grade revisions, or by any other causes. The extent of the territory covered by these unusual conditions and the amount and kind of material involved should be investigated. The distribution of ties for later use in track should be noted.

If ties were procured from a forest, grown by the carrier for tie-production purposes, data as to the location, extent and age of the forest, and as to the amount of the ties produced should be secured, as should information as to whether ties were made by carrier's or by contractor's forces, and as to the general conditions related to production and handling of the ties prior to their use in the track.

The name of the maker, the place produced, the point at which they were delivered to the carrier, and the date placed in track, and other governing conditions should be ascertained for all steel, concrete or other manufactured or assembled ties.

RAILS.

(I. C. C. ACCOUNT No. 9.)

Records should be searched for such information as to rails as will enable the carrier's engineer to present for use all the data that may be required to show fully the kind of rails and their characteristics, the source of their supply, and methods of their handling, so that the reasons for, and the facts of, the entire cost of rails may be noted.

Separate notes should be made to cover the rails in each separate track; and all rails in tracks should be included in the investigation, even though rails in quarry tracks, in gravel pit tracks, etc., may not be chargeable to the account "Rails." Rails not laid in tracks should be given proper attention in like manner. An effort should be made to segregate in

the notes by definite locations and descriptions, all rails that were included in one purchase or shipment and that have had the same history.

A reference should be made to the contract and to the specifications under which the rails were purchased. Notes should be made showing whether rail was purchased as first or second quality, or as rerolled rail, showing the percentage of short rails allowable, and the punching, and showing the character of the rails as determined by the process of manufacture or the use of alloys, as Bessemer, open hearth, iron, manganese, etc.

The brand on the rails will usually show where and when they were rolled and their weight. The date when rails were laid, and their service to date, should be ascertained.

It should be ascertained whether the rails on any given section were laid in their present position or as relay rails. If they were laid as relay rails, the place where they were originally laid, the amount of service obtained from them, and the date when relaid, should be ascertained, in addition to the information outlined as desired for new rails.

OTHER TRACK MATERIAL.

(I. C. C. ACCOUNT No. 10.)

The carrier's engineer should obtain such information as to frogs and switches and track fastenings as will enable him to present for use all the descriptive data when necessary for combining with the list of material to make a complete descriptive inventory that will reflect costs.

Separate notes should be made to cover such material in each separate track, without regard to its location; such material not now used in tracks should also be inventoried.

Standard plans for simple turnouts of various angles and for crossovers between tracks built at standard

distances apart should be studied, as should the design of standard rigid, spring rail and movable point frogs, so that any variations from standards can be quickly noted by inspection. Plans for special crossing frogs, for single and double slip switches, for three-throw and tandem switches, for connections to interlocking towers, and for other specially designed combinations of material, should be consulted, for information as to their makeup and weights, etc.

The contracts and specifications under which any of the various classes of material were purchased should be referred to. The name of the manufacturer and the location of his plant, the trade name, if any, of his product, the character of the material as determined by the process of manufacture, the date when placed in track, should all be ascertained.

The punching of angle bars, frogs and switch points, and the insulation of any of the material, have a bearing on the cost of the material.

The use of electricity for lighting purposes in connection with switch lamps, or of any other substitute for the standard oil lamp, should be noted and described.

The depth and character of special foundations for crossings of electric railroads or other steam railroads should be investigated.

Where second-hand material has been installed its condition at date of installation should be ascertained.

Where the carrier has established a plant for the manufacture of any of the material the fact should be considered in connection with the valuation.

BALLAST.

(I. C. C. ACCOUNT No. 11.)

Ballast constitutes an important item of expense, and in considering it the exercise of great care will be required, not only in arriving at the correct quantities of ballast that have been applied to the roadbed, but

also in uncovering information as to all of the conditions faced in procuring the ballast material for use and in getting it distributed in the roadbed.

The plans, showing the standard ballast section for the different kinds of ballast on the different classes of tracks should be referred to, but it must be remembered that this represents neither the maximum nor the average but the minimum section intended. The average weight per cubic yard of the ballast should be ascertained.

Separate notes should be made as to ballast for each separate track, as the amount and the kind of ballast and the time of application may vary greatly on adjacent tracks. An attempt should be made to determine the limits of the ballast applications made in any one year, as actually made as determined from construction figures, or as part of any one continuous job, from any one source of supply, and under the same general conditions, as such segregation may make it possible to determine the proper amounts to be assessed against the ballast in the various sections, for development expenses and overhead expenses of various kinds, etc., both at the source of supply and the point of delivery.

The various kinds of ballast, such as gravel, sand, cinders, slag, chats, crushed rock, burnt clay, etc., may come from widely different sources, and may be procured at costs that vary greatly in different localities for the same class of material. The costs are affected by the location of the point of use and the original source of ballast actually in the track, by reason of its bearing on transportation and work-train expense; the cost of the land or of any royalties paid for material, the average output, the kind, character and amount of equipment, the force required to operate the equipment, the amount of tracks and the amount of shifting and maintenance of them required; the source of fuel and water supply and facilities for providing it; the

amount of development work required and the difficulties in stripping, loading, dredging, quarrying, blasting, washing, screening, burning in beds, etc., as needed to procure the particular kind of ballast; the work-train service required in unloading; the types of cars; difficulties experienced in unloading; the location of the labor market; height of each ballast raise and the number of raises.

The history of the original application of ballast should be obtained as far as possible. Material originally applied may have settled into the embankment below subgrade, and tests should be made to disclose such facts. Dirt, ashes and clinkers may foul the ballast so that the real amount cannot be told without investigation. Much ballast may have been used to take out sags in the track caused by settling roadbeds, or in connection with grade revisions, and the amount of ballast may be much greater than a casual inspection would indicate. The use of pick and shovel at frequent intervals to disclose actual conditions relating to ballast applications should be resorted to. Rock or corduroy placed under ballast to keep it from sinking into the roadbed below subgrade should be noted.

In cases where cross-section notes or other records can be obtained to show the total amount of material that has been taken from a given source, it may be possible to check the total amount against the amounts found along the line, and thus account for all of the material that has been distributed.

Where extensive ballast work is undertaken on some section previously not ballasted, or where no ballast has been applied in several years, the widening of embankments may be required, and information should be sought about such work as may have been performed.

Where any of the work connected with procuring and distributing ballast is done under contract, reference

should be made to the contract and its terms should be noted. The portions of work done under contract should be definitely determined and distinguished from the work done by the carrier's forces. Facilities furnished the contractor, such as transportation, fuel, water supply, work trains, tracks, equipment, etc., should be noted.

All these conditions must be considered in connection with cost of reproduction, especially the cost of transportation, which will be the largest item of all.

TRACK-LAYING AND SURFACING.
(I. C. C. ACCOUNT No. 12.)

The determination of the cost of track-laying and surfacing separate from other costs is dependent on certain elements of which only part can be determined in the field; the remainder must be determined from records. The consideration and presentation of information as to conditions attendant on the prosecution of the work are necessary to enable a proper estimate to be made.

An element in the cost of track-laying and surfacing is the material yard expenses, where a portion or all of the material is stored, such as the expenses due to handling the material into and out of the yard, to switching service, to the construction of any special tracks, racks or platforms, etc., required, and other expenses incurred for any specific job; and such as a proper proportion of the general expenses of the yard, including cost of site, cost of grading done, of construction of office, of wages of superintendent, timekeeper, watchmen, etc. The location of the material yard where any of the material was stored, with respect to the job, has a bearing on the cost of transportation.

The character and the quantities of track material used in a unit of distance affects the total cost of the work, as, for instance, the lengths of rail and their weight

per yard; the type, the number of pieces in, and the weight of, each joint and the number per mile; the number of bolts per joint and per mile; the number and type of nutlocks, tie plates, base plates for use under joints, rail braces, anti-creepers, etc.; the kind of spikes, such as drive or screw; the number used per mile and per tie on straight track, and the number used on curves and turnouts; the size, weight and number per mile of cross-ties; the amount of material in standard turnouts, as determined by the angle of the turnout; the weight per cubic yard of the ballast, its kind, the number of yards per mile, and the height of the total raise and of each raise.

The kind of job, in connection with which track-laying and surfacing is done, has a large influence on the cost; additional main tracks may often be laid at less cost than the first single track, on main or branch lines, because the additional track job can profit by the use of the first track for transportation and communication; revisions of alignment and short changes of line may be laid at a high cost, because of the expense of many connections to the original tracks for diversions of traffic over the new line, or to permit access to work trains; yards and terminals; passing tracks, spurs; temporary tracks for material storage; diversion of traffic or transportation of construction of material; track changes during construction; renewals of rail; widening of gauge; the laying or removing of a third or compromise rail, etc., all have special and separate problems.

In surfacing track, different costs accrue through the use of different methods, such as by the use of a skeleton surface to permit the use of track by ballast trains and other work trains, instead of use of a full surface with dirt; by the use of dirt from the shoulder of the roadbed for surfacing, instead of from outside of the roadway, or dirt hauled in from a distance; by the use

of sufficient ballast to secure full standard depth at one raise, instead of application of small amounts and several raises to secure full ballast sections; by the completion of surfacing and ballasting before the track is in operation, instead of ballasting under traffic.

The position in point of time when track is laid when surfaced with dirt, when each application of ballast is made, when renewals of rail of greater weight are made, the character and quantity of materials used, methods employed in surfacing, whether track is laid by hand or with track-laying machine, the amount of traffic over lines where ballasting and rail renewal work is in progress, the methods used in distributing material, the weights of material for use in calculating transportation charges, the use of revenue trains, work trains, or teams, in distributing ties and track fastenings, the amount of force employed, the time consumed, and the kind and amount of tools and equipment used, the amount of rentals and demurrage for cars held, the character of the adjacent country, noting the frequent occurrence of swamps, or of high fills or deep cuts, or of other conditions that might increase the difficulties of track-laying and surfacing, should be determined.

RIGHT-OF-WAY FENCES.

(I. C. C. ACCOUNT No. 13.)

The item of the inventory, "Right-of-Way Fences" will include right-of-way fences (including permanent snow and sand fences erected in lieu of right-of-way fences), farm gates, cattle guards, wing fences, aprons and hedges. Fences around stockyards, fuel stations, station grounds, shop grounds and building sites, will be classed with the particular building or structure to which they apply, but as the information desired about them is practically the same as about right-of-way fences, they may be inspected and considered at the same time.

Where fence charts are available they will be used to check up right-of-way fence. The carrier's standard plans for the various types of fence in use should be studied, so that any departures from standard construction can be readily noted. Where there is any doubt as to the ownership of the fences, special investigation should be made.

The date when the fences were constructed in their present location should be ascertained, as the information may be used not only to indicate the probable life of the fence, but also in some instances to throw light on the ownership and use of other property.

Fences along wagon roads outside of right of way may have been built by the carrier; for instance, fences along roads that were changed because of appropriation of old highway location by the railroad, along roads changed in location to permit use of under or over grade crossings, along temporary highways, or along temporary tracks during construction.

The kind of material, such as timber, hardware, stone, etc., and the dimensions, where necessary, and the weight per unit, in each separate type of construction of fences, together with the source of supply and the f. o. b. point should be investigated. Where special manufactured units, such as concrete, iron or combination posts, such as wire stays, patent gates, special metal or combination cattle guards, woven wire fences and barbed wire of various gauges, etc., are used, the manufacturer's name, the location of his plant, the trade name, if any, of his product and a catalogue reference, should be given. Where any of the specially constructed items are made at the carrier's shops, or elsewhere, by its forces, attendant conditions should be described.

The digging of post holes constitutes an important item in the cost of building fences. The depth and diameter of holes, the character of the material encount-

ered, and the amount of blasting, if any, required, should be noted. The amount of excavation required for the pit and the bridge types of cattle guards and for foundations for masonry fences, also should be noted.

The character of the country, noted as to whether wet and boggy, abounding in quicksand, boulders and solid rock, or dry and admitting of easy digging; as to whether rough and broken, or level; as to whether covered with trees and shrubs, or bare, has a bearing on the cost of distributing material, making the necessary excavations, clearing the ground and erecting the fence. The roughness or smoothness of the country and the irregularities of the boundaries of the tracts to be fenced has a bearing on the cost of engineering required in staking out the fences.

The location of the material yard, with respect to the job; the apportionment of material yard expenses to the fence work, the manner of transporting the material to the job and of distributing it, as by work trains or teams; the location of the labor market; the force employed, and the equipment for housing it; the time consumed; the tools used, are all items that affect the cost of the fence.

SNOW AND SAND FENCES AND SNOW SHEDS.

(I. C. C. ACCOUNT No. 14.)

Substantially the same information is desired about items under this heading as is desired about right-of-way fences.

CROSSINGS AND SIGNS.

(I. C. C. ACCOUNT No. 15.)

Under this heading should be included data relating to construction for the purpose of, and in connection with carrying farm passes, roads, streets, other public highways and railroads (excepting railroad crossings at grade), at grade, over or under grade, across the

carrier's right of way; data relating to all signs of every kind and character on the right of way; to highway crossing alarms; to planking; to paving; and to watch-houses at crossings, crossing gates, etc.

The cost of shop and station overgrade foot bridges and subways not public highways, are properly included in the cost of the buildings, but as the information desired about them is like unto that desired about similar items, classed under "Crossings and Signs," they may be inspected and considered at the same time. The cost of bridges or trestles carrying tracks over roads, highways or other railroads, is properly chargeable to the account "Bridges, Trestles and Culverts," and the cost of bridges or other structures carrying farm passes, highways, or tracks of other railroads, over the carrier's tracks, is chargeable to the account "Crossings and Signs." All bridges, however, of any character, for non-grade crossings, should be carefully investigated after the manner hereinbefore outlined for the consideration of bridges, trestles and culverts, under the account "Bridges, Trestles and Culverts."

Plans, both standard and special, for any of the construction work, should be inspected for general information and for data as to any special work not readily discovered by inspection.

All signs, of every kind and character, on the right of way, should be noted, and should be identified with standards shown on plans, or should be noted as to their variations therefrom. Difficulties experienced in digging holes for setting signs, extra grading required, and any fire protection at the foot of the sign should be noted. In general, however, the signs on structures will be included with the structures to which they belong.

Information relating to the apportionment of the cost of construction and of maintenance, between the carrier and any other party or parties, of any crossings,

should be secured, as should information as to who maintains the crossing. In looking up such information care should be taken to ascertain who constructed, who paid for, and who maintains the various improvements in the neighborhood of the crossing, such as paving, sewers, drains, curbing, sidewalks, retaining walls, etc., and if the carrier paid any portion of the cost the kind and amount of quantities involved, and the conditions attendant on construction should be described. Many such items constructed by the carrier are not easily seen to be a part of the railroad construction. Where inquiry does not readily bring forth information desired a search should be made of the records of both the city or county and the carrier, to ascertain if any special assessments were levied against the carrier to cover such improvements. Separate investigation should be made in connection with each crossing, as improvements on each crossing may have been installed at widely different times and under different circumstances. Determine in all cases whether the carrier would be required by law to reproduce structures, the cost of which was wholly or partly borne by other parties at time of actual construction; if so, they should be included in the cost of reproduction.

The installation of special crossing construction, and of adjacent and auxiliary improvements, may have been made free by the carrier in return for franchises that were granted to it, or for streets and alleys that were closed in its favor, or for other services rendered or favors bestowed.

The construction of approaches to crossings, in the cost of which the carrier has participated, may have necessitated payments to liquidate damages to abutting property, and may have necessitated the purchase of the property.

Temporary highway crossings for use during railroad construction and temporary tracks to permit special highway crossing construction should be investigated.

The usual information required as to material: its kind, weight, source of supply, f.o.b. point, its trade name, pattern number, standard number, its manufacturer, the method of handling it at the material yard, the manner of transporting and unloading or distributing it, etc., should be determined and compiled.

The time consumed in prosecuting work, the amount of force employed, tools and equipment used; the handling of part or all of the work by a contractor; methods employed, etc., all should be investigated.

STATION AND OFFICE BUILDINGS.

(I. C. C. ACCOUNT No. 16.)

There shall be included under this heading all station and office structures; their fixtures, appurtenances, and furniture necessary to equip the buildings for use; the necessary grading and preparing of grounds for the buildings; the sidewalks, driveways and fences thereon; permanent water rights for buildings; and fees and expenses of architects.

The structures and details included under this account, as listed in the Classification of Investment in Road and Equipment, are numerous and of great variety, and careful attention to detail must be observed if all items of cost are included.

Plans for all structures, showing general layout and details, should be secured, so that they can be checked sufficiently to identify them with the existing structures.

In addition to identifying each structure by its location, its name, its character, by the use made of the structure and of its various parts, by its dimensions and cubical contents above ground floor, such special information as to its details, and as to the conditions attendant on construction should be ascertained as

will enable the forming of an intelligent opinion as to costs.

The age of the structures and of their several parts and appurtenances should be determined by ascertaining the dates when they were first built, as per the plans examined, and when rebuilt or modified, if at all; the extent to which modified should be determined, and the plans governing the changes should be examined. If buildings have been moved or converted from one use to another, the facts and conditions should be determined.

When analyzing cost records construction work done by contract should be noted, as should the name of the contractor, terms of the contract, the location of a copy thereof in custodian's file, the specifications, the limits of the work, any facilities furnished free or at reduced rates to the contractor by the carrier, etc. Contract work covering special installations, such as lighting systems, heating plants, special wiring for inter-communicating telephones and call bells, toilet facilities and other plumbing work, elevators, pneumatic tubes, circulating drinking water systems, water supply, drainage and sewer systems in buildings, special paving, roofing, decoration of interior, etc., should be specially investigated for information as to quantities, conditions and costs. Bills of material, showing what was installed under contract, will assist in detection of extra facilities or items that were installed.

Where record quantities are available to show what grading was done they should be used; where records are not available, such measurements and tests should be made as are required to show the quantities and classifications involved; the source of supply and the method of transporting the material should be ascertained. Where structures are placed on "made" ground the fact should be specially noted and search should be made for hidden grading quantities.

The foundations for, composition of, and amounts of, any paving and curbing should be determined; and similar information should be obtained for walks and drives; for retaining walls and for platforms with gravel, brick or other surface finish; sodded areas and the beautifying of grounds should be noted.

The kind and character, unit weights and dimensions of any material; the source of supply, f.o.b. point, should be ascertained. Where any specially manufactured articles are used the name of the manufacturer, the location of his plant, the trade name, if any, of his product, the type, size and shop number and a catalogue reference, etc., should be ascertained also.

Material yard and store department costs and the transportation of material should be estimated.

Examination should be made for indications of any special or unusual material used in the construction, such as treated or rare timbers, expensive interior finishing material, special aggregate in concrete masonry, special plastering material, sheet-iron products of special gauge, etc. Painting on structures should be observed, and where the carrier has used its paint of standard color and composition it should be noted and a reference to the standard should be secured.

The foundations of all structures, including not only buildings but also track scales, freight cranes and other heavy facilities, should be given special attention. Information should be sought as to any preliminary expenses incurred for sinking test holes, borings, piling or spread footings which may be suspected under large structures. In soft ground the use of piling or grillage under masonry foundations; the use of cofferdams, caissons, or sheet piling during construction, because of water or quicksand, and the use of pumping machinery to lower the water level during construction, should be investigated. The classification and the amount of material excavated, for both cellars and foundations,

the depth of the foundations, size of footings, composition of the masonry, etc., should be investigated. Foundations of special size to permit future enlargements of the structure should be noted. The kind and amount of any waterproofing used with concrete or other masonry should be noted also.

The contents of buildings, such as furniture and fixtures, should be covered by a careful inventory. In cases where several buildings of standard designs and similar use are to be inventoried, such as depots of various classes, a descriptive list should be made, showing the standard kind and amount of furniture and fixtures that should be found in each building, so that any departures from standard kinds and quantities can be quickly observed and properly noted. Special furniture and fixtures should be inspected sufficiently to enable identification with standard plans, manufacturer's catalogue types and sizes, etc. The shop numbers of machines, their maker's name and his location, their size, power and capacity, and their catalogue reference, should be ascertained. The age of machines and of other special fixtures also should be ascertained, as should the date when any modifications in the type or use, or changes in location may have been made.

When the inventory is being made all items should be included as separate units if they have been so acquired; for instance, bases, anchor bolts, belting and lacing, gas engines' starters, mufflers, special lubricators, etc., are not always included in the manufacturer's price of an engine; and the foundations of engines and of machines of various kinds, with their sometimes high costs, because of the kind and quantity of material used, and because of the nature of the ground, which may require blasting or piling, grillage, spread foundations, or great depth, are distinct from the machines, and are subjects for special investigations; for instance, hose should not be included with the hose cart or fire engine, nor nozzles with the hose, as each indicate separate and distinct costs.

The source of supply of gas and electricity for lighting and of gas, electricity, steam, hot water, etc., for heating buildings, and the source of water supply, should be investigated. If the supply is generated or produced outside of the building and is purchased by the carrier, the extent of the wiring or the piping system that is owned by the carrier outside of the building should be determined, together with information as to the number, kind, size, length of wires and poles, etc., and as to kinds and weights and sizes of pipes, kind of pipe joints, any protective material used around pipes, depth they are laid in ground, the number, size and kind of valves and other specials, the ownership, type, size, maker and manufacturer's number of any meters, transformers, etc. Contract price paid for the supply, the pressure at which it is supplied and amounts used should be noted.

If the supply is generated or produced outside of the building, by the carrier, information similar to that outlined above should be obtained with reference to the supply system outside of the building and between it and the power plant or a main supply line that serves other buildings; the main supply lines should be described in connection with the principal facilities which they serve.

Drainage and sewer systems leading from the buildings should be investigated, and locations, lengths, depths laid, sizes, kinds, the style of joints, etc., should be ascertained; similar information should be obtained, together with the ownership and point of discharge, about any trunk line or main line into which such sewers discharge.

Fire protection facilities should be investigated, and where special pipe lines have been laid they should be

located and described; the source of supply of water should be ascertained.

Inter-track fences, hedges, fences about buildings, should all be considered as outlined under the title "Right-of-Way Fences."

Station foot-bridges and subways should be considered as outlined under the title "Crossings and Signs."

For cost data and reproduction program the time required to complete construction, force employed, and the amount and kind of tools and special equipment used, should be determined, if practicable, together with full description of methods employed.

ROADWAY BUILDINGS.

(I. C. C. ACCOUNT No. 17.)

There shall be included under this heading office buildings used exclusively for maintenance of way, roadway shops, and other roadway buildings, together with drainage, water, gas and sewer pipes and connections; and all machinery, fixtures and furniture used to complete buildings ready for use. The architect's fees should be ascertained and noted. The cost of the grading and preparation of grounds, the construction of sidewalks, driveways and fences therein, as well as the dimensions and the nature thereof, should be ascertained and noted. The cost and extent of permanent water rights for buildings should be ascertained and noted.

A representative list of roadway structures is given in the Classification of Investment in Road and Equipment.

The general plan of investigation outlined for use in connection with Station and Office Buildings will apply to roadway buildings.

WATER STATIONS.

(I. C. C. ACCOUNT No. 18.)

There shall be considered under this heading all structures, facilities, and appliances that are used to

equip for service stations for supplying water, including grading and preparation of grounds, the construction of walks, driveways, and fences therein, and the cost of permanent water rights.

Water stations used solely for supplying water to shops, power plants, stations, hotels, tenement houses, or section houses, will be included, when properly classified, with those facilities; and temporary water stations established only for use during the construction period will be classified and included with the work on account of which the water station was used; but as the data required about a water station for one use is similar to that required about all others, where like conditions exist, the outlined suggestions as to investigating obscure quantities and conditions will apply to all.

The Source of Water Supply should first be ascertained. Where water is purchased, the name of the party from whom it is procured, the price paid, the average consumption, the extent of the carrying facilities owned by the carrier, and the size, type, the maker, shop number and ownership of any meter used, should be determined.

In locations where water from a single source is used for more than one building or kind of service, the facilities used to convey, store and deliver the water for use of each building or service, should be classified therewith, after being inventoried, and described, and the consumption of water at each of such places relative to the entire consumption at the station should be determined as closely as possible.

The conditions under which water stations are used on jointly owned or operated lines of railroad should be investigated.

When the source of water supply is in the carrier's possession and the facilities are operated by it, a description of the source and of the facilities thereat, as

well as a description of the conveying and storing facilities, should be procured.

Water Development Expenses incurred in connection with securing a suitable source of supply should be considered. The securing of samples of water from various sources for analysis, the gauging of streams, where measurements of discharge of springs, the sinking of test wells, the making of pumping tests, soil bearing tests at foundation sites, surveys, temporary sources developed for use during development of a larger and more permanent supply, are all in the nature of development expenses. Inquiry should develop considerable information along this line.

Closely allied to water development expenses are costs due to pumps, filters, and temporary construction abandoned on completion of reservoir construction or other permanent facilities; to wells abandoned on account of poor quality or insufficient quantity of water; or to entire water stations that have been abandoned because of failure of the supply. Inquiry from local employes may bring forth information of great value. Water station facilities that have been abandoned should be described as fully as possible.

The dates when any facilities were installed or acquired or when moved, modified, or abandoned, should be ascertained.

Surface or Living Water Supply, such as is procured by the carrier from any source other than wells, as lakes, streams, springs, or from intercepted underflow classed with streams, where the right to use sufficient water to supply railroad needs must be secured from some other party or from some governmental authority, the costs of acquiring the water rights enjoyed and the conditions attendant on securing them, should be investigated. Such costs and conditions might result from, and accompany, the purchase of, or payments for,

relinquishment of riparian rights; payments to secure releases from damages to others, due to appropriation of the water; the making of surveys and the filing of applications for permits to make use of water under statutory limits; the purchase of rights, the clearing of titles, transferring the point of appropriation, and class of use; the purchase of land to secure rights, or to protect water supply, construction work accomplished as consideration for the purpose of securing joint right with others to use of water, etc.

Diversion dams, reservoirs, settling basins, special intakes, screens, syphons, curbing and covers, etc., are types of construction that may be used to develop, render available, or conserve the source of supply where water is secured from lakes, springs or streams. The sizes, depths and character of masonry foundations and dams; the character of, and quantities involved in, cut-off walls and in core walls; in riprap and paving on embankments or sides of reservoirs; in clean-out facilties; in spillways; in gatehouses and covers; in facilities for collecting water into a sump or well; in any strainers or filters used; or in any other development, conservation, or protection facilities at the source of supply, should be investigated and described, and the methods and difficulties attending construction should be noted. Special plans may be found to cover the general and detailed features of such work.

Wells are widely used as a source of water supply for railroad purposes; and because of the varied conditions under which they are put down, a careful investigation is necessary in order to uncover all the facts connected with them that indicate definite costs. The depth and diameter of the wells; the character and the thickness of the various strata of material encountered; the depth of, and the character and amounts of, material

used for curbing; and the methods that were necessary and were used in sinking the wells and applying the curbing, all have a bearing on costs.

Dug wells may have been made in stable ground by excavating to the bottom without curbing, and then building up the curbing as a wall; where the earth is not stable or water is a hindrance, it may have been necessary to apply the curbing by underpinning, as the excavating progressed, or to build the curbing on the surface and then lower it by undermining it. The use of a cast-iron cutting shoe or other special construction under the curbing; the use of pumps for lowering the water level to permit excavating to be done by hand; the use of an orange-peel bucket to excavate below the water level; the difficulties resulting from the getting the curbing out of plumb or set so that it would not sink when undermined; and other construction conditions should be investigated. The height of water in dug wells may indicate probable construction methods used. Where dug wells do not furnish an abundant supply of water, drive points are often sunk into and below the bottom of the well, or tunnels may be drifted out horizontally from near the bottom to develop greater supply.

Driven wells are usually shallow and small in diameter; the diameter, length and kind of casing and of drive point should be ascertained. Note the number of any gauge on the well point.

Tubular wells in different localities vary greatly in diameter, depth and costs. Records should be searched for data as to the depth of the well, the depth to which it is cased, the depth below the surface of any reductions in diameter that may have been made when drilling, the diameter of the well as drilled, at the top and at the bottom, and as to the diameter of the well at each point of reduction. Where the well is cased from top to bottom the inner casing at the top usually indicates the diameter at the bottom; larger diameters, however, may have been used in drilling the well for certain depths, and where these larger pipes are not visible at the surface because they have been cut off or pulled, records must be searched for evidence of their use, as well as for data as to the amount of any such casing used. It should be noted that drive caps and drive shoes of proper diameter were required for each size of casing used, and packers at points of reduction.

In some instances perforated casing of considerable length has been dropped into a well otherwise uncased, to rest on the bottom of the well and prevent soft water-bearing rock from caving; perforated lengths are sometimes inserted in the string of casing a considerable distance above the bottom of the well to admit water from a high water-bearing stratum; and casing is often slotted after it is in place in the well.

The pipe used for casing may be line pipe, drive pipe, flush-joint tubing, etc.; and the material may be galvanized iron, black or galvanized wrought pipe, or special steel pipe; and the joints may be riveted, inserted, flush, or screw and socket, etc.; and the costs will vary with each of these features, as well as with the diameter and the weight of the pipe per linear foot.

Brass strainers or screens represent a considerable item of cost in a well, and the use of a screen should be investigated; the diameter, the length, the trade name, and the name of the manufacturer are necessary.

The use of pump columns and working barrels should be noted and described in connection with pumps.

Investigation should be made for information as to any difficulties encountered in sinking wells, especially in cases where very deep wells are concerned. The necessity for use of under-reamers, the occurrence of quicksand, or of other material that is unusually difficult of penetration, the loss of tools that necessitated long delays to permit fishing for them, difficulties that

forced abandonment of partially completed wells, and the starting of new ones, are illustrations of some of the conditions that may be encountered. Wells that have been put down at great expense but have developed an insufficient supply of water or none at all should be especially investigated; such wells may have been filled up to a high level to permit use of a small supply to be secured through slotted casing near the surface, or may have been abandoned and filled to the top; where such filling has been done it should be ascertained whether or not any casing was covered.

Flowing wells are usually produced in the same manner as other wells of the same general type and should be similarly investigated; all other types of wells should be thoroughly investigated.

Gravity pipe lines and long-pressure pipe lines should be carefully studied, in order that the many and varied conditions attendant on their design and construction can be properly explained and noted.

Long pipe lines frequently lead from sources of supply that are located off the carrier's right of way; where such is the case the title that the carrier has to the source should be examined, as should the title to the land necessary for the construction, maintenance and operation of the pipe line.

Because of pressure conditions, considerations of cost, and conditions affecting the rate of flow of water, more than one size and kind of pipe is frequently used in a long pipe line; where such conditions exist the limits of each kind and size of pipe should be determined. The characteristics of each kind of pipe used should be considered; cast-iron pipe should be considered not only as to its diameter and its weight per length, but also as to its type of joints, and as to the kind of joint sealing material used, as pig lead and jute, lead wool, etc.; wrought-iron or

wrought-steel pipe may be black, galvanized or specially treated as to surface finish, and may have screw and socket, universal, flanged, joints, etc., and its weight per foot may vary not only with its diameter but with the requirements of the specifications as to its thickness and strength; wood stave pipe should be considered as to its kind of wood, thickness of staves, gauge of wire bands, and amount of wire used per foot of pipe, type of joints, specifications as to strength, treatment of pipe, such as dipping in asphaltum, etc.; spiral riveted pipe, vitrified tile for light-grade gravity lines, and other kinds of pipe, should be described in such detail that costs can be calculated.

In localities where the soil content is such that wrought pipe quickly pits and deteriorates, as in alkali-saturated soil, the pipe may be specially painted or dipped; or it may be wrapped with burlap or asbestos felt and then dipped in or painted with asphaltum at the factory or at the site of the pipe line; when such conditions are suspected, an investigation should be made and a full description obtained.

Pipe fittings and specials, such as elbows, tees, branches, valves of various types, increasers and reducers, special joints, blowoffs, air valves, pressure regulators, etc., should be adequately described; the existence of blowoffs at all low points and of air valves at all summits and the frequent occurrence of valves should be sought.

General construction conditions should be investigated. Profiles of long lines can usually be obtained, which will show the depth below surface that pipe is laid; the classification of material excavated is of importance and special attention should be given to cases where wet excavation quantities were handled, so that difficulties and extra work required may be described; stream crossings should be examined for

evidences of piling supports, riprap and other protection, and for special conditions encountered; the manner of excavating, as by hand, with teams, with excavating machines, etc., should be ascertained; clearing and grubbing quantities should not be overlooked. Note should be made of the condition of wagon roads and their location with reference to the pipe line, and the accessibility of the work, as affecting team haul and distribution of material. The kind and amount of tools, for excavating trench, wrapping and laying pipe; and the method of sheltering and boarding laborers, the moving of camps, the character of the country, should be noted.

Telephone lines should be described, with information as to kind, length and set of poles, kind and gauge of wires, types of bracket and insulators; the soil conditions that would affect setting of poles, should be noted.

Construction in connection with gravity pipe lines, to reduce pressure, or to change conditions of flow, such as mechanical pressure regulators, concrete boxes or small reservoirs, should be noted.

The ownership of fences at or near the source of supply and along the pipe line should be ascertained, and if they were built by the carrier they should be described; all fences about water station facilities should be similarly described.

Pipe lines other than gravity or long pressure lines, such as distributing lines about stations and shop grounds, may be similarly investigated as to general features. Where maps do not show all the pipe lines, records should be searched and old employes questioned, and sketches should be made of all definite information acquired. The special fittings in a distributing system may be numerous and of great variety, and should be so described that they can be identified with standards and catalogue references.

The use of pits or boxes and manholes about certain specials, should be noted and described.

Buildings should be investigated in a general way as per outline set down under Station and Office Buildings. Such structures as pump and boiler houses, lime houses and other buildings in connection with water-treating plants, roofs or covers for standard dug wells and pump pits, standard fuel-pit covers, etc., are usually covered either by a standard or by a special plan that is available, so that any variations or departures from the plan can be quickly noted.

Tanks should be considered as to the following points: Identification and agreement with carrier's or manufacturer's standard or special plans; capacity of the tub; kind and amount of wood and hardware in wood tanks, gauge of plates in steel tanks and weight of tanks, and material in other tanks; roof and frost box; spouts, with valves and fittings, and their relation to standards; kind and size of supply, discharge and overflow pipes, with valves and connections; base casting; clean out facilities; drain for pit and overflow; indicator board and ladder; amount of timber and hardware in wood supports for tubs; weight of steel in steel supports and of other material in special supports; foundations; the material excavated, the size, depth and character of footings, the use of piling, grillage or spread footings under masonry, and of reinforcement in concrete backfilling. Where second-hand tanks are erected, there is sometimes installed a masonry foundation larger than standard for that tank in order that it may be in place for use with a future tank of larger dimensions. Second-hand tanks should be considered as to original location, dates first erected, taken down and re-erected; and as to amount of new material installed in tank when re-erected.

All tanks should be inspected for float valves, altitude valves, or other means of controlling flow of water into tanks.

Standpipes as installed should be considered as follows: Conformity to and identification with carrier's standard plans for pit, cover, and location with respect to track and to manufacturer's size and type of valve, column and spout; the height of column and length of spout; drains; excavation for pit; floor of pit, walls and cover; size and character of footings, use of piling to support pit masonry; location of gate valve, etc.

Water-softening plants should be considered as to the following points: Kind of system used, as continuous or intermittent; name of manufacturer and name of type of plant used; kind of chemicals used in treatment or kind of treatment used other than chemical; location of mixing plant; capacity of mixing chamber and of clear water storage; capacity of plant per 24 hours; material excavated for foundations, material used in foundations and difficulties of installation; dimensions and character of superstructure; facilities for sludge removal and drains; supply and discharge piping; ladder or stairs; conformity to plans, etc.

Windmills should be considered as follows: name of maker, trade name, type, material, length of stroke, diameter of wheel; height of tower and character and amount of material therein; foundations for tower posts; kind, size and amount of pump rods and couplings from mill to pump or to well casing; any automatic device for throwing mill into or out of gear, etc.

Pump pits: Consider as to dimensions; classification of excavation; amount and character of material in floor and walls; special foundations and method of building walls; waterproofing of walls and floor; drains, tunnels to wells; roof, etc.

Fuel tank pits: Consider as to dimensions; excavation; material in floor, walls and cover; dimensions and capacity of tank; gauge of material in tank; connections to other tanks, etc.

Track tanks, flumes, and all of the various special installations for supplying water should be so described, in detail and in conformity to general outlines for ordinary installations, that all quantities and costs may be reflected in the notes.

Pumping machinery and accessories, used in connection with water stations, represent many types of machines and reflect varied costs and should be sufficiently described to enable ready identification with or determination of similarity to manufacturer's standard types and sizes, and to enable the proper determination of costs of installation.

The manufacturer's name, the location of his plant, and the trade name of his product, the shop number of the item, and a catalogue reference, should be ascertained in connection with each separate machine or separately acquired accessory when practicable. As a supplement to such information and further as a substitute for it if it cannot be obtained, a description as to size, type, and characteristics should be given. The points to be considered in securing the information desired about some of the more commonly used kinds of equipment are outlined as follows:

Steam boilers: The type, as water tube, fire tube, internally or externally fired, vertical, horizontal, economic, locomotive, marine, etc.; the nominal horsepower; the diameter and length; the weight; the number, length, diameter and gauge of tubes; the heating surface; kind of grates and grate area; size and kind of stack; kind and amount of material used in setting; thickness of shell; flue sheet and firebox; mounted or unmounted and kind of base; size of steam and water connections; size of dome; gauge pressure allowable, etc. Boiler

accessories may not have been included in the purchase price of the boiler and should be listed separately; as the injector, its maker's name, its type, horsepower, capacity; size of connections; the steam gauge, its case, size, graduation type, etc., the water column and water gauge; the feedwater pump and piping, etc. Automatic stokers, fuel economizers, and ash handling devices should be listed separately. Character of the ground and the amount and character of material in boiler foundations should be noted.

Feed water heaters: Type, as open or closed, vertical or horizontal; nominal horsepower; number, length, diameter and gauge of tubes; size of feed and discharge connections. Note any special lagging.

Steam engines: Type, as vertical, horizontal, simple, compound, triple, etc., throttling or automatic, condensing or non-condensing; center or side crank; horsepower; weight; diameter and length of steam cylinder; size and weight of flywheel; diameter and face of pulley; size and length of steam and exhaust pipes; belting; lubricators; base, as self-contained or built up. The anchor bolts and kind and amount of other material used in foundations should be determined.

Gasoline and oil engines: The type, as vertical, horizontal, geared base, combined pumper, etc.; horsepower; weight; number and size of flywheels; diameter and face of pulley; lever or wheel operated friction clutch; diameter of cylinder; length of stroke and R.P.M.; belting; direct connection to other machine; coiling system and piping; extended shaft and face plate; batteries; igniter; magneto; diameter and length of feed suction and return pipes; exhaust pot and connections; starter tank, with valve, gauge and connections; deep-well attachments; lubricator; anchor bolts; foundation material and excavation. Combined gasoline or oil engines and pumps should be described as gasoline engines and power pumps; manufacturer's

combination number should be obtained. Where geared base gasoline engines are used, the pitman and connections should be separately listed; as should deep-well packing heads or stuffing boxes used therewith to be noted as to size of suction and discharge piping, size plunger, length of stroke, etc.

Steam pumps: Type, as horizontal, vertical, simplex, duplex, simple, etc.; piston or plunger pattern; single or double acting; how packed, as outside center, outside end, inside, etc.; diameter of steam cylinder; diameter of water cylinder, and length of stroke; brass or other special lining and trimming; diameter of suction, discharge and steam connections and length of piping; suction or discharge air chamber; foot valve or strainer; pressure designed for; foundations.

Power pumps: Type, as horizontal, vertical, simplex, duplex, triple, single or double acting; diameter and face of pulley; belting; direct connection to operating machine; diameter of cylinder and length of stroke; piston or plunger pattern; brass or other special lining; how packed; size of suction and discharge connections and length of piping; foot valve or strainer; suction or discharge air chamber; pressure designed for; weight; kind of base; anchor belts; and foundations. Machines commonly called windmill pumps and those known as deep-well working heads can be described by use of such of this outline as applies; pitmans and pumprods should be described.

Centrifugal pumps: Type, as horizontal, vertical, side or bottom, and single or double suction; with or without hand primer; iron, brass or iron with brass fittings; diameter and length of suction and discharge piping; foot valve; diameter and face of pulley; direct connection to operating machine; single or multi-stage. Where vertical multi-stage pumps are used the depth of pump below application of power should be measured and the size and amount of shafting, boxes,

couplings, check valves, extra piping for oiling, priming, etc., should be ascertained. The comparatively new patented turbine pumps for use in well casings will require special description.

Electric generator: Type, as belt driven or direct connected, direct or alternating current; series, shunt, or compound wound; revolving field or armature, etc.; weight; kilowatts; voltage, amperes; phase; cycles; pulley face and diameter; belting; belt tightener; idler pulley; exciter; switchboard and switch; ammeter; voltmeter; rheostat; generator base; foundations.

Electric motor: Type, as open or enclosed, direct or alternating current, vertical or horizontal shaft, constant or variable speed, belted or direct connected; series, shunt or compound wound; backgeared; weight; kilowatts; volts, phase; cycles; number of speeds and R.P.M. for each; pulley diameter and face; belting; starter; with or without slide rails; secondary shaft and mounting for backgeared motor; motor base or mounting; anchor bolts and foundations; transformers, as to kilowatts, primary and secondary voltage, etc.; source of power; extent of transmission system belonging to carrier.

Pump jacks: Type, as single or double geared, belt driven or direct connected, with or without flywheel; iron, wood, or other kind of frame; kind of sub-base; amount and character of foundation material; horsepower; diameter and face of pulley; lever or wheel operated clutch pulley; size and kind of pitman; weight.

Working barrels or deep-well cylinders: Inside and outside diameters, length of stroke; length of cylinder; weight; spool, ball or other style check and plunger; number of leathers on plunger; all brass, iron case brass lined, etc.; depth set in well; set in casing or in pumping column; diameter of column; kind and dimensions of pump rods and couplings; single or double acting.

Air compressors: Type, as belt driven, steam actuated, direct or cross connected to gasoline or oil engine, horizontal or vertical; diameter of steam and of air cylinders and length of stroke; diameter of air inlet, air outlet, steam inlet and exhaust, and water jacket with length of piping; weight; horsepower required; R.P.M.; piston displacement, cubic feet per minute; simplex, duplex, single or double stage; intercooler; cooling water facilities; flywheel size; base; foundations. When air is compressed with gasoline engine, the engine should be described as per outline for gasoline engines; where steam power is used the outline for steam engines should be observed. Air tanks or receivers are to be found in connection with each compressor and should be noted as to the following points: Diameter, length, horizontal or vertical type, thickness of shell and of heads; size of air inlet and outlet; diameter of safety valve and pressure at which it blows off; weight; manhole; gauge of metal.

Motors: Type, as simple, compound, disk, current, venturi, etc.; ownership; size of connections; screwed, flanged, or bell and spigot connections; used with fishtrap; by-pass composition; serial number; trade name; registering device, etc.; pit and cover for motor.

Where water is procured from wells by use of the air lift, the amount and size of pipe from the air tank to well and from well to water storage tank should be ascertained, as should the size and amount of air supply pipe in the well; the size of the well casing; the size and amount of discharge pipe in well. Any special air nozzle at the lower end of the air pipe and the cap at the top of the well casing should be described. As a check on the ascertained amounts of pipe in the well there may be secured information as to the air pressure required to start water and to keep it flowing, the amount discharged, the water level when the lift is not in use, etc.

Where water must be hauled in tank cars from source of supply to another water station, not only should the producing, the loading, the unloading and the handling and storing facilities be described, but also information should be secured as to equipment required for hauling water, amount hauled and method of hauling, etc., so that the costs of the service may be determined.

When electric power for pumping purposes is supplied from a source outside of the carrier's water station the installation should be considered as to source of supply, as to kind of current, as alternating or direct, phase, cycles, voltage, etc., kind and ownership of transmission line, as to amount of current used and rate paid for current. Steam furnished from a central plant should be similarly considered, with attention given to delivery pipes and any special protection for them, depth laid in the ground, the limit of the lines chargeable to water station account, etc.

The age of all installations, the movements of machinery or other portions of installations from one point to another, and any additions to or modifications of them, should be noted.

Any work done by a contractor should be distinguished from work done by the carrier's forces and a reference to the contract obtained.

The source of material supply, the conditions attending transportation and distribution, and material yard expenses, should be considered.

FUEL STATIONS.

(I. C. C. ACCOUNT No. 19.)

There shall be included under this heading all structures, facilities other than tracks, and appliances necessary to equip service stations for supplying fuel to locomotives and to floating equipment, including the cost of grading and preparing grounds and of constructing driveways and fences therein. Fuel stations, coal houses, etc., used solely for supplying fuel to shops, power plants, stations, hotels, tenement houses, or section houses, should be classed with the buildings or facilities which they serve, but where methods of inspection and investigation outlined below are applicable they may be employed.

The factors of information desired and the methods to be employed to secure data as to obscure items in connection with fuel stations are substantially the same as those outlined in connection with station and office buildings, as to use of plans, the age of, and modifications in, the structures, and parts thereof; the division of ownership and maintenance of jointly owned or used property; the determination of the extent and conditions of contract work; grading; the kind and source of supply of material; painting; the material yard expenses; the methods of transportation; the time consumed in construction; the force employed, and the tools and equipment used.

Where special installations of machinery have been made for dumping coal, for elevating it, or for weighing it, the machinery should be carefully checked against plans and all necessary information should be obtained as to manufacturer's types and standards, as to manufacturer's name and plant location, catalogue references, etc. Special care should be used to separate into its component parts any installation that has been assembled from various sources. The power used to operate machinery and the method of its application should be described.

The storage capacity of coal platforms, of bins in conveyor-type stations, and of pockets, should be noted.

Where coal is stored under water, the pit walls, floor and foundations should be investigated, as should the source of water supply, facilities for drainage of pits,

and methods and facilities for depositing and recovering coal.

The foundations of structures should receive attention. Mud sills or other foundations under platforms, the penetration of piling in trestle approaches, the bearings under framed bents, the foundations under fuel oil tanks and small buildings and under special machinery should be noted. Where large structures are constructed or pits are installed special attention should be directed to ascertaining foundation quantities and costs. The amount and classification of excavation and amount of backfilling; preliminary tests to determine bearing power of soil; the use of piling, grillage or spread footings under masonry; the depth, size and character of footings; the use of sheet piling or cofferdams; the use of pumping equipment to keep down the water level in pits; the quantities and composition of masonry; the use of waterproofing material for pit masonry, etc., should be investigated.

Where sand and cinders are handled in connection with coaling stations the facilities should be noted and investigated, special attention being given to foundations of cinder pits.

The diameter, length, composition and strength of cables used in hoists should be noted.

At coal platforms where derricks are used the kind and capacity of buckets; kind, equipment and capacity of derricks; and the kind and source of power used should be noted.

Fuel oil columns, and tanks, sumps, pumps, piping, valves and fittings, will require substantially the same method of investigation and the same factors of information as are outlined for similar facilities for handling water, under water stations.

Facilities for providing fire protection should be investigated, as should facilities for furnishing lights.

In cases where electric power is used for operating machinery, the source of power, the kind of current, the rate paid for it, the kind and ownership of transformers, and the extent of ownership by the carrier of the transmission line should be ascertained.

SHOPS AND ENGINEHOUSES.

(I. C. C. ACCOUNT No. 20.)

There shall be included under this heading buildings used as shops, other than shops devoted solely to maintenance of way and structures; enginehouses; storehouses for company material; permanent foundations, including those for machinery and apparatus; furniture and fixtures other than shop machinery and tools; drainage, sewerage and water supply systems; and plants for heating and lighting purposes. There shall be included also the necessary grading of grounds, the sidewalks, driveways and fences therein. Architects' fees; and the cost of permanent water rights should be ascertained and noted. Distinct power-plant buildings, however, for shop purposes, shall be classified under "Power-Plant Buildings," and distribution systems leading from such power plants to shops and enginehouses shall be classified under "Power Distributing Systems."

An illustrative list of facilities that shall be classified under this account is shown in the Classification of Investment in Road and Equipment.

In securing descriptive information relative to, and in compiling the inventory of, shops and enginehouses, special note should be made of those shops used solely for maintenance of way and structures which are not investigated under this account, so that omission or duplication shall not result, and the facilities shall be investigated and inventoried under their proper classification. Similarly, when permanent foundations are inventoried, special note should be made not only of the foundations inventoried under this account, but also of

the special foundations that are to be classified under "Shop Machinery," and which are not inventoried with this account, so that omission or duplication shall be avoided. And further, such procedure should be followed in investigating and inventorying furniture and fixtures other than those that should be classified under "Shop Machinery"; in inventorying power-plant buildings and distributing systems.

The factors of information desired and the methods to be employed to secure data relative to obscure items in connection with shops and enginehouses are substantially the same as those outlined in connection with Station and Office Buildings, as to the use of plans; the location and use of structures; the age of, and any modifications in, the structures; the division of ownership and maintenance of jointly owned or used property; the determination of the extent and governing conditions of any work done by contractors; special installations of contract facilities; grading; paving; driveways; walks; the source of supply, the kind and weight of material; special materials; painting; the material yard and the apportionment of its expense; the method of transportation and distribution; foundations; furniture and fixtures; light, heat, power, sewerage and water supply facilities and their source of supply; fences; foot bridges; the time required for construction; the force employed; and the tools and equipment used during construction.

Turntables should be given special attention as the excavation is often difficult and the use of sheet piling and pumping equipment may be required. Piling or spread footings are often used under the center, and foundations of great depth may be required. The foundation or base under pit paving should be ascertained, as should the kind and extent of drainage facilities. The source of supply of electric current for tractors should also be ascertained.

Where drop pits have been installed an investigation should be made to ascertain any special difficulties encountered in making the excavation that may have necessitated the use of sheet piling, pumping equipment, etc.; and the use of foundation piling or grillage, or the use of spread footings, excess masonry quantities and waterproofing material, should be investigated.

The amount of filling required under floors and the base and composition of paving for floors should be ascertained.

Cinder pits and stall pits for enginehouses are often installed in soft or "made" ground and require spread footings or other excess quantities.

The difficulties encountered and the great length of time consumed in completing construction sometimes occasions high costs for engineering and superintendence and for rental and repair of equipment used in construction.

GRAIN ELEVATORS.
(I. C. C. ACCOUNT No. 21.)

There shall be included under this item of the inventory, structures for the transfer, treatment and storage of grain, including conveyors, machinery and fixtures therein, the grading of the grounds and the walks, driveways and fences thereon. The architects' fees should be ascertained and noted. Small storage elevators at way stations where grain is received for shipment should be classed as station buildings; only large elevators in which a regular grain business is handled or grain is stored for various owners should be classed as grain elevators. All storage or grain elevators should be noted, however, to the extent of showing whether they are included or omitted from this account.

Substantially the same methods of investigation and the same factors of information are required in connection with grain elevators as are outlined in connection with Station and Office Buildings. Grading of grounds before and after construction and the foundations of the structures should be subjects of special investigation, as should special machinery, and the foundations therefor.

STORAGE WAREHOUSES.
(I. C. C. ACCOUNT No. 22.)

There shall be included under this heading, storage warehouses, including machinery and fixtures therein, and including the grading of grounds before and after construction, and the construction of walks, drives and fences therein. The ordinary freight warehouses or stations where freight is received for shipment are not to be classified under this account, but only warehouses in which merchandise is stored and which the railway companies or others operate commercially as storage warehouses.

Substantially the same methods of investigation and the same factors of information are required in connection with storage warehouses as are outlined in connection with Station and Office Buildings. Grading of grounds before and after construction and the foundations of the structures should be subjects of special investigation.

WHARVES AND DOCKS.
(I. C. C. ACCOUNT No. 23.)

There shall be included under this heading, wharves, docks, dry docks, slips, float bridges, and other landings for vessels, including the necessary dredging, and the float bridge machinery; also the piling, pile protection, cribs, cofferdams, walls, and other necessary devices and apparatus for the operation or protection

of wharves and docks; also the necessary grading of grounds, and the construction of walks, driveways, and fences therein.

The land on which wharves have been built and the riparian or water rights for wharves and docks are classified under "Land for Transportation Purposes," but should be considered in connection with this account, to the extent of making general notes in connection therewith when inspecting wharves and docks.

Buildings located on wharves should be classified under the account appropriate for the class of building, but note of all such buildings should be made under this account to the end that there may be no omissions.

Special attention should be given to foundations, which present a field for many excess quantities and costs; the arrangement of anchor piles and tie rods, and data as to quantities and costs of all hidden work should be ascertained.

In general the methods of investigation outlined and the factors of information listed as desired under "Station and Office Buildings" are applicable to this account; such are those relating to the use of plans; the age of, and modifications in, the structures and parts thereof; the division of ownership and maintenance; contract work; grading; source of supply and kind of material, etc.; material yard; transportation; foundations; machinery; time consumed, forces employed, and tools and equipment used in construction.

COAL AND ORE WHARVES.
(I. C. C. ACCOUNT No. 24.)

Under this heading shall be included wharves and docks for the transfer, treatment, blending or storage of coal or ore, including the necessary dredging, conveyors, machinery and fixtures; and including the grading of grounds and the construction of walks,

driveways and fences therein. Small transfer or storage trestles at stations where coal is stored or delivered should be classed as station buildings.

The land on which coal and ore wharves have been built and the riparian or water rights for such wharves should be classified under "Land for Transportation Purposes," but should be considered in connection with this account also, to the extent of making general notes in connection therewith when inspecting the coal and ore wharves.

Special attention should be given to grading quantities and costs and to foundations, as those items may properly include many excess quantities and costs that are obscure.

In general the methods of investigation outlined and the factors of information listed as desired under Station and Office Buildings are applicable to this account; such are those relating to the use of plans; the age of, and modifications in, the structures and parts thereof; the division of ownership and maintenance; contract work; grading; source of supply and kind of material, etc.; material yard; transportation; foundations; machinery; time consumed, forces employed, and tools and equipment used in construction.

GAS-PRODUCING PLANTS.
(I. C. C. ACCOUNT No. 25.)

There shall be included under this heading gas-producing and gas-compressing plants, and the machinery and appliances in such plants; and including the grading of grounds, and the construction of walks, driveways and fences therein.

The grading quantities and the foundations under structures should be given special attention, as these items may include many items of hidden quantities and costs. The foundations under machinery should be considered separately from the machinery.

In general, the methods of investigation outlined and the factors of information listed as desired under "Station and Office Buildings" are applicable to this account; such as those relating to the use of plans; the age of, and modifications in, the structures and parts thereof; the division of ownership and maintenance; contract work; grading; source of supply and kind of material, etc.; material yard; transportation; foundations; machinery; time consumed, forces employed and tools and equipment used in construction.

The machinery and appliances should be considered, generally, in the same manner as is outlined for the pumping machinery and auxiliary equipment under "Water Stations."

TELEGRAPH AND TELEPHONE LINES.
(I. C. C. ACCOUNT No. 26.)

There shall be included under this heading all telegraph and telephone lines, including terminal equipment.

Information should be procured as to the division of ownership and maintenance of telegraph and telephone lines and auxiliary facilities located partially or wholly on the carrier's property and as to who constructed the line and who maintains it. The terms of any contract or agreement should be noted. Where the carrier has no interest in the ownership or use of telegraph or telephone lines on its property, the location of such lines generally should be noted and the rights of the owners to use the right of way should be investigated, but no detailed inventory should be taken.

For cost data for reproduction purposes, work done by contractors should be distinguished from that done by the carrier's forces, and a reference to the governing contract should be obtained.

The kind and character; the sizes, dimensions, and unit weights of material used; the source of supply, the f. o. b. point and the point of delivery to the carrier should be ascertained; and where any special manufactured and assembled articles are used the name of the manufacturer, the location of his plant, the trade name, if any, of his product, the type, serial number, and a catalogue reference, etc., also should be ascertained.

The method of handling and transporting material should be noted; the location of the material yard where the material may have been stored, and the apportionment of its expenses to the job; the transportation of material to the job and its distribution by trains or teams or other means should be ascertained.

Standard plans for various kinds of terminal layouts and special plans covering special installations should be consulted.

The dates when any portion of a telegraph or telephone line was constructed or modified should be ascertained to show the age thereof.

The specifications under which telegraph and telephone lines were built should be consulted for information as to types of hidden construction.

Poles should be considered as to kind of material; weight; length; diameter at butt and at top; depth set in ground in different classes of material; kind and amount of treatment, if any; painting or special protection at ground surface; the number used per mile; original height and present height where cut off and set down. Mounds of gravel or stones about poles for fire protection should be noted.

Wires should be considered as to number, kind of material; gauge number; covering or insulation; amount of sag allowed.

Guy wires should be noted as to size of wire, length, strength and as to anchoring.

Lightning arresters in cable boxes and at switchboards in stations should be noted as should special lightning arresters in stations and terminals for further protection of sensitive instruments.

Aerial cables should be considered as to number of wires used, kind and gauge of wires, insulation on wires, and kind of tape or other cover over wires. The use of cables to take care of and protect telegraph and telephone lines during adjacent construction should be investigated. All appurtenances of cable boxes should be noted.

Attention should be given to the transposition of telephone lines and to the standard or the special systems used.

All underground construction should be investigated and information should be secured from records as much as possible. Information should be procured as to the sizes, kinds, and qualities of conduit material; the use of concrete or other base and the use of concrete casing around conduit; the kind of joints and joint sealing material; the depth of conduits; the character of the material excavated; the excavation, floors, walls and covers of manholes; the kind, gauge, wrapping of wires in cables and the cable cover.

In cases where electric generators, motors, and auxiliary equipment are used to supply current to lines, such machinery and equipment should be adequately described to enable its identification with manufacturer's standards; each accessory or separately acquired auxiliary should be separately considered, as should foundation for machines, where current is purchased for use, the source of supply, the kind of current, the rate paid and the ownership of motors, transformers and transmission line should be ascertained.

The kind of material encountered in excavating holes for poles and trenches for conduits has a large bearing on costs; notes should be made as to kind of soil, as wet,

boggy, gravel, quicksand, rock requiring blasting, etc.; paving that must be removed and replaced increases cost of conduit construction.

The nature of the country through which lines are built, as affecting cost of distribution of material, the supply of laborers and the manner of caring for them, the time consumed, the force employed and the kind and amount of tools and equipment used should be noted.

SIGNALS AND INTERLOCKERS.
(I. C. C. ACCOUNT No. 27.)

Under this heading shall be included interlocking and other signal apparatus for governing the movement of trains, including towers and other buildings in connection therewith; and including the necessary grading of grounds and the construction of walks, driveways, or fences therein.

The division of ownership and maintenance of any signals and interlockers on jointly owned or operated property should be ascertained as should information as to who constructed and who maintains the facilities.

Plans should be procured, where available, of all structures and of all signal and interlocker layouts so that they may be checked against actual construction and any departures from plans readily noted.

The age of structures and other facilities should be determined by ascertaining the dates of construction or of installation and of any modifications. The installation of second-hand material should be noted, and information should be obtained as to date and place of original installation and date when released.

Information as to the kind, sizes, dimensions, and unit weights of material; the source of supply, the f. o. b. point, the location of the material yard and the apportionment of its expenses; the methods of transportation;

and the methods of distribution to the locations where such material is used should be considered.

The foundations under interlocker towers and all other buildings, under the various functions, semaphores, signal bridges, and under machinery should be specially investigated for excess quantities and for special difficulties encountered in construction. The use of piling, grillage or of spread footings for masonry foundations on soft or "made" ground, and the use of sheet piling, and pumping equipment should be investigated.

Backfilling and grading quantities about buildings, interlocker towers and the various functions should be investigated.

The furniture and fixtures in buildings and the heat, lights and water supply should be considered as per outline given under "Station and Office Buildings" for similar facilities.

In connection with interlocker installations in addition to those enumerated in the report on signals and interlockers, by the Sub-Committee of the Presidents' Conference Committee, the following items are some of the many that should be considered and described:

The kind of tower, as brick, wood, or special composition; wood towers are sometimes more costly than those of brick or permanent construction because of trimmings and design.

The distance of functions from towers, as having a bearing on costs.

The use of alternating or of direct current for track circuits, with their attendant differences in installation and costs.

The kind of wire used and its gauge and weight.

Track changes or additions within interlocker control limits, necessitating changes in the plant.

The source of supply of electric power used. Where the current is purchased, the kind of current, its voltage, phase, cycles, the ownership of motors, transformers

and transmission line should be ascertained. Current is sometimes purchased of kind that can be directly applied to use. The duplicate or alternative equipment for providing power should be described.

In connection with electric block signals, the following items are some of the many that should be given consideration:

The character and types of signals and relays.

Kind and location of track indicators for warning maintainers.

Methods of securing lightning protection; where lightning arresters are on poles, the kind and type of arrester should be noted, as should the kind and size of ground wire and the kind and depth of ground installation; where arresters at leadouts are in the battery case the method of securing ground contact should be noted.

The types of insulated joints and method and place of assembly.

Electric locking of switches to prevent the throwing of switches when trains are within the limits of control and to warn approaching trains of open switches.

The connection of side-track derails with track circuits so that main line signals show danger when derails are open.

The connection of electric crossing bells with signal circuits; the length of control.

The use of separate pole lines. The kind of poles, length, diameter at butt and at top; kind of treatment, if any, painting or special protection, especially at the surface of the ground, the depth set in the ground, kind of soil encountered in excavating, number of poles per mile, etc., should be ascertained.

The kind of wire used for aerial work, for cables and for underground work, its gauge and its weight.

The location and description of charging stations and equipment. The types and a full description of the component parts of the equipment should be noted.

Where power is purchased the source of supply, the kind of current, the rate paid for current, and the ownership of meters, transformers, and transmission, should be ascertained.

Kind of bond wires and the length and manner of application; the number of wires in cables, the kind of wire, and its gauge and insulation, and the tape or covering.

The terminal board arrangement.

Pipe elbows in signal foundations, for carrying wires; trunking; conduits.

POWER DAMS, CANALS AND PIPE LINES.

(I. C. C. ACCOUNT No. 28.)

There should be included under this heading all dams, canals, pipe lines and accessories devoted to the utilization of water power for the operation of trains and cars and to furnish power, heat and light for general purposes.

The factors of information desired and methods of investigation to be used in connection with this account are substantially the same as were outlined under "Water Stations," for such items as the source of supply, the acquirement of riparian or other rights to use water; the location and construction of pipe lines, dams and reservoirs; preliminary investigation and development expense; the age of facilities or parts thereof, etc.

Bridges, viaducts, foot bridges, and similar structures should be investigated as per outline given under the account "Bridges, Trestles and Culverts."

The division of ownership and maintenance and information as to who constructed and who maintains the facilities, should be ascertained. Plans should be consulted in connection with all features of the work that have been covered by such plans. Work done by contract should be distinguished from work done by

carrier's forces and a reference to contract should be secured.

Special attention should be given to the foundations of masonry dams and of embankments for reservoirs. The depth of any curtain walls, facilities for draining reservoirs, protection against wave wash, and the kind and extent of the spillway should be investigated.

The ownership of all fences in the vicinity of reservoirs and along canals should be investigated, as the fence may have been constructed as a protection for such facilities. The time consumed, the force employed, and the kind and amount of tools and equipment used in construction work should be noted.

POWER PLANT BUILDINGS.
(I. C. C. ACCOUNT No. 29.)

There shall be included under this heading the buildings of power plants erected to furnish power for the operation of trains and cars, and to furnish power, heat and light for stations, shops, and general purposes; permanent foundations including those for machinery and apparatus; drainage, water, and sewer pipes and their connections; fixtures and wiring for lighting and heating, and miscellaneous furniture and fixtures. There shall be included also the necessary grading to prepare the grounds and the construction of walks, driveways, and fences therein.

Substantially the same factors of information and the same methods or investigations are required in connection with this account as are outlined in connection with the account "Station and Office Buildings."

In general, the grading in connection with the buildings, and the foundations should receive special attention, as they may properly include many obscure items of excess quantities and costs.

Although only permanent foundations for machinery are to be classed with the buildings, all special foundations should be noted also, in order that there may be no omission of foundation quantities.

POWER SUBSTATION BUILDINGS.
(I. C. C. ACCOUNT No. 30.)

Under this heading should be included buildings of power substations (including storage battery stations) erected to transform power for the operation of trains and cars, and to furnish power for heat, light, and general purposes; permanent foundations including those for machinery and other apparatus; drainage, water, and sewer pipes and their connections; fixtures including wiring for lighting and heating and miscellaneous furniture and fixtures. There shall be included also the necessary grading for preparation of the grounds and the construction of sidewalks, driveways, and fences therein.

Substation machinery and other apparatus for transforming or storing power in power substations shall be included under "Power Sub-station Apparatus."

The same factors of information and the same methods of investigation are required in connection with power sub-station buildings as are outlined for use in connection with "Station and Office Buildings." The grading around buildings should be especially investigated, as should foundations for structures.

Although only the permanent foundations for machinery are classified under this account, the temporary and special foundations for machinery which are classified under "Power Sub-station Apparatus" should be noted in order that there may be no omission of these foundations from both accounts.

POWER TRANSMISSION SYSTEMS.
(I. C. C. ACCOUNT No. 31.)

Under this heading should be included the cost of high-tension transmission systems, whether overhead, surface, or underground, used for transferring power from producing plants to a place where it is transformed for propelling trains and cars or for power, heat and light for general purposes. When an electric current, generated or received, is changed by means of transformers or other apparatus, that portion of the line or outside conductor system carrying current other than the operating kind or voltage, should be classed as transmission system. When the electric current is generated or received and used substantially unchanged in voltage and kind, the line or outside conductor system, including feeders, trolley wires, booster circuits and supplementary return, shall be classed as distribution system.

The factors of information desired and the methods of investigation required in connection with power transmission systems are substantially the same as those outlined in connection with telegraph and telephone lines and in connection with signals and interlockers.

In cases where the carrier has extensive installations of power transmission systems, they will be especially listed and special instructions will be issued when needed to cover special features.

POWER DISTRIBUTION SYSTEMS.
(I. C. C. ACCOUNT No. 32.)

There shall be included under this heading the distribution systems, whether overhead, surface, or underground, for transferring low-tension electric power to producing plants or transformer stations, and for transferring steam and compressed-air power from producing plants to a place where used for propelling

trains and cars or for power, heat, light, and general purposes. Track material such as insulated rail splices used in connection with distribution systems shall be classified under "Other Track Material," but should be noted in connection with distribution systems with which it is used in order that there may be no omission of such items. The portion of distribution systems located within shop buildings and station and office buildings shall be classed with those buildings. When electric current, generated or received, is transformed, that portion of the outside conductor system carrying current of other than the operating kind, shall be classed as transmission system. When the electric current is generated or received and used substantially unchanged in voltage, the outside-conductor system shall be classed as distribution system.

Substantially the same factors of information are desired and the same methods of investigation are applicable in connection with feed and guard wires, overhead trolley wires, transmission wires, etc., under this account as are outlined in connection with similar material and facilities classified under "Telegraph and Telephone Lines" and under "Signals." The pipe lines for steam and compressed air, with their accessories and methods of installation, should be considered substantially as are pipe lines in connection with "Water Stations" and in connection with "Station and Office Buildings."

POWER-LINE POLES AND FIXTURES.
(I. C. C. ACCOUNT No. 33.)

Under this heading should be included the cost of poles, cross-arms, insulating pins, brackets and other pole fixtures, braces and other supports for holding the poles in position and structures for supporting the overhead railway construction. The items that are classified under this account should be considered and

investigated substantially as are the installations of similar kinds and classes of material, which are classified under "Telegraph and Telephone Lines," and "Signals."

Where the carrier has extensive installations, special instructions should be issued.

UNDERGROUND CONDUITS.
(I. C. C. ACCOUNT No. 34.)

There shall be included under this heading conduits required for underground wires and cables of electric railway construction, including manhole and sewer connections, sewer traps, and all details necessary for the completion of the conduits. Facilities under this account should be considered substantially as per outline covering similar facilities in connection with "Telegraph and Telephone Lines." An accurate description should be obtained of the difficulties encountered in construction and kind and quantity of material that has been employed, as a large part of the facilities cannot be inspected.

MISCELLANEOUS STRUCTURES.
(I. C. C. ACCOUNT No. 35.)

Under this heading shall be included all permanent structures not provided for under other accounts, including all fixtures and furniture to equip them for use. In general, the factors of information desired and the methods of investigation outlined in connection with station and office buildings should be considered and applied with respect to structures that are to be classified under this account.

PAVING.
(I. C. C. ACCOUNT No. 36.)

Under this heading shall be included the paving about tracks in public highways through which the

carrier's tracks are laid. Paving upon the carrier's lands within the grounds of buildings or other structures shall be classified in the account provided for those structures and the paving upon the right of way at crossings shall be classified under "Crossings and Signs." All such paving, however, shall be noted and shall be investigated as outlined below in order that there may be no omission of paving quantities in the inventory.

The division of ownership and maintenance and information as to who installed and who maintains the paving, and who would be required to install and maintain in case of reproduction under present laws, should be ascertained.

In cost data and reproduction estimates, any work done by contractors should be distinguished from work done by the carrier's forces and a reference to the contract should be secured.

Search should be made for information as to any grading that was required in connection with paving, and for information as to the character and thickness of the base prepared for the paving and as to the kind and character of the paving proper.

The specifications under which paving was installed should be consulted, as should any sketches and plans showing cross-sections of the work. The date when paving was installed; the source of supply of material; the unit weights; the methods of handling, transporting and distributing material; the time consumed, the force employed and the kind and amount of tools and equipment used in construction, should be ascertained.

Special investigation should be made of paving at all street crossings of the railroad and at all streets adjacent to railroad property, as paving on streets may have been constructed by the carrier in return for franchises that were granted, or the carrier may have participated

in the cost of pavement constructed from funds secured from special assessment.

ROADWAY MACHINES.
(I. C. C. ACCOUNT No. 37.)

The heading "Roadway Machines," shall include roadway machines provided for the maintenance of roadway and structures, after the opening of the road for commercial traffic.

An illustrative list of some of the roadway machines is given in the classification of Investment in Road and Equipment.

Road machines used in connection with addition and betterment work or on new construction work, should be investigated and described, and the conditions under which they were acquired and used, and the use now being made of them should be ascertained; for though such machines are classified under the account covering the work in connection with which they are used, it is desirable to note all roadway machines to prevent omissions. Likewise similar machines used in connection with the equipment of shops and classified as shop machinery, should be noted to prevent omissions. Further, roadway machines, such as pile drivers, concrete mixers, etc., when permanently mounted for use on the carrier's tracks and properly to be classified as "Work Equipment," should be noted in connection with "Roadway Machines" in order that omission may not result.

The division of ownership and of maintenance of machines used on jointly owned or used property should be obtained.

An effort should be made to identify each roadway machine and to connect it with records of its purchase, of its use, and of any modifications or additions that have been made to it. Any number, name, or other

definite means of designation that may have been applied by the carrier should be noted.

The builder's name and the location of his plant; the trade name of his product; the f. o. b. point; the builder's serial number and type; and a catalogue reference should be ascertained.

In general, sizes, dimensions, capacities, types, methods of applying power, sources of power and means of producing it, weights, ages, quality of materials, etc., should be noted in connection with each machine.

Accessories not regularly furnished by the builders of machines and included in the purchase price should be noted separately.

Special kinds and quantities of machinery, grading outfits, etc., may necessitate the use of special instructions which will be provided when needed.

ROADWAY SMALL TOOLS.
(I. C. C. ACCOUNT No. 38.)

Under this heading shall be included all roadway and track small tools provided for the maintenance of way and structures after the opening of the road for commercial traffic.

In general, this will include all tools used by section, extra, bridge and carpenter gangs, pump repairers, signal maintainers, watchmen and tenders, and small track and bridge tools used on pile drivers, steam shovels, wrecking cranes, etc.

Draw distinction between tools identified with the machine used, in connection with the work the machine does.

Such small tools that have been or are being used on addition and betterment or on new construction work, should be noted also, and the conditions under which they were acquired and used, ascertained in order that there may be no omissions.

A list of small roadway tools is given, for illustrative purposes, in the classification of Investment in Road and Equipment.

Where sets of standard plans are available, they should be used in connection with checking-up tools, so that those which conform to plans can be readily classified as to types, uses, weights, etc.

The sources from which the various classes of tools are usually secured and the method of purchasing and handling them; their types, uses, weights; the kind and quality of material used; their strength, capacity, etc., should generally be noted. Catalogue references to types will be desirable.

The division of ownership and of cost of repairs to tools used on jointly owned or used property should be ascertained.

ASSESSMENTS FOR PUBLIC IMPROVEMENTS.

(I. C. C. ACCOUNT No. 39.)

There shall be included under this heading, the carrier's proportion of the cost of constructing street improvements, such as grading, sewering, curbing, paving and sidewalks; and other public improvements, including cost of such improvements made by the carrier's own employes under Government requirements.

The paving required by Government authority between rails and adjacent tracks laid through public highways, shall eventually be classified under paving, but should be investigated in connection with other items under this account for the purpose of preventing omission and of uncovering items properly classified under this account.

Where any improvements have been made in streets that cross the right of way and in those adjacent to or near the carrier's property, the city and county records as well as the carrier's records should

be searched for information as to any costs that were paid by the carrier. Each crossing and street should be considered separately, as the time and the conditions under which work was done may have differed materially in each case. Underground improvements, such as sanitary and storm water sewers, should be specially investigated. At all points where streets are depressed or are elevated to eliminate grade crossings with the railroad, there will probably be found some quantities involved in the construction of public improvements, a portion or all of which were paid for by the carrier.

Where large drainage schemes have been originated by counties, townships, districts, etc., and construction has taken place, a search should be made to ascertain what, if any, portion of the expense was borne by the carrier.

Levee construction and other protection against overflow from swamps or streams; bridging and ditching on the right of way to permit the crossing of public drainage, irrigation or water supply ditches, the construction of portions of artificial lighting systems, etc., are some forms of construction that may be required of carriers in connection with public improvements.

Information as to who maintains such improvements and as to the division of the cost of maintenance should be obtained.

REVENUES AND OPERATING EXPENSES DURING CONSTRUCTION.

(I. C. C. ACCOUNT No. 40.)

The actual results of operation during construction and development will be investigated under the head of Financial Histories and Intangible Values. The estimated results of revenue and operating expenses

during reproduction and physical development will be based on the construction program for reproduction.

COST OF ROAD PURCHASED.
(I. C. C. ACCOUNT No. 41.)

This is an accounting sub-division and cannot be inventoried. Any statements required in connection with this account will be compiled from the carrier's accounting records.

The limits of lines of road that were purchased should be determined so that segregation of items on the inventory can be made for those limits.

This account relates to original cost only.

RECONSTRUCTION OF ROAD PURCHASED.
(I. C. C. ACCOUNT No. 42.)

This is an accounting sub-division and cannot be inventoried or checked up in the field. Any statements required in connection with this account will be compiled from the carrier's accounting records.

This account relates to original cost only.

OTHER EXPENDITURES—ROAD.
(I. C. C. ACCOUNT No. 43.)

There shall be included in this heading, items which cannot be properly included under any of the foregoing accounts as a part of the cost of any specific work, such as the cost of transportation of men, materials, supplies, and equipment over the carrier's own line; amounts paid for rent and repairs of equipment and for injuries to persons incident to and in connection with the original road, road extensions or additions and betterments; and analogous items.

The items of expense classified under this account will be used in connection with the determination of unit prices to be applied in reproduction estimates and the actual costs will be included in original cost statements.

Information as to the nature of the country that may have made it difficult to keep laborers on the job and that made frequent or continuous recruiting necessary, should be ascertained, as should the location of the normal labor markets with respect to the job, and the use of more or distant markets because of scarcity of men. Inquiry should be made as to any accidents that may have occasioned injuries to persons or loss of life; and as to excess of equipment transported for general use.

In general, most of the information of the kind that would be classified under this account will be uncovered in connection with other accounts and will be uncovered from records by office forces unless special instructions are issued to the contrary.

SHOP MACHINERY.
(I. C. C. ACCOUNT No. 44.)

In listing machinery included in this account, it is advisable to treat each Shop separately, filling out all required forms for the various machines located therein. When completed, the forms will represent an inventory by Shops which will be helpful in the location of the machines and should be complete in itself.

Several of the carriers have adopted the use of "Types" applying to the shafts, hangers, braces, etc., which they have found advantageous when listing these items under Account 44, "Overhead Machinery." By this means it is convenient to locate and list such overhead machinery in groups as well as to list and total same by shops.

There shall be included under this account all machinery and other apparatus in shops and engine houses, including special foundations and installation and small hand tools used to equip the shop.

Permanent foundations are to be classified with the buildings but should be considered and investi-

gated in connection with the machinery installed thereon in order that there may be no omission of them.

An illustrative list of some forms of shop machinery is given in the classification of Investment in Road and Equipment; this list should be much extended to be inclusive of all kinds of installations classed as shop machinery. Shop tools should be considered separately from machinery and should include all equipment that is portable.

Special means should be employed to designate each machine by the location of the building in which it is contained, by its location in the building, by its class, its use, and its shop number, so that it can be identified in connection with records that have been made and that will be made. If the carrier has no shop number assigned to the machine, the question of having such a number assigned and applied to the machine by means of a brass plate should be taken up. Where shop numbers that have been used in records are not found on the machines, an effort should be made to identify them with the old numbers.

The division of ownership and maintenance, and information as to who installed and who maintains machinery on jointly owned or used property should be ascertained.

In connection with each machine and each separately acquired accessory there should be ascertained the builder's or sales agent's name; the location of his plant; the trade name of his product; the f.o.b. point and point of delivery to the carrier's line; catalogue reference showing the name, number and date of the catalogue and the page, figure, and code covering it; the manufacturer's type and serial number; the net and the shipping weights; and the space occupied.

The date when a machine was built and was installed and the date of any modification therein or of any transfers will be of value. Information should be

secured as to the original and present location, the original and the present shop number assigned by the carrier, and the extent and character of any modifications that have been made in the transferred machinery.

The nature and extent of any additions and betterments to any machine should be described.

Where special plans are available showing the installation of intricate layouts, they should be consulted and used in inspecting machinery. The installation of some kinds of intricate machinery may have been made by the builder's forces; such work should be noted.

The foundations of machines should be investigated for hidden quantities. The quantity and classification of material excavated, the size, depth and character of footings, the use of piling or grillage under masonry foundations for large machines, such as steam hammers; the use of spread footings, and the use of anchor bolts and large screws or other fastenings, should be investigated and noted. Special notes should be made to indicate that the foundations are included with or are omitted from the descriptions of the machines or equipment superimposed thereon and the reasons for any omission should be given. The kind, unit weights, composition and source of supply of foundation material should be ascertained.

Special attachments to and accessories of machines should be separately considered and noted; such as motors, belting, countershafting, etc., for driving machines; and such as pressure gauges, and injectors, on boilers, etc.

The kind of power used to drive machinery, such as electric, steam, air or hand, should be noted; where power is purchased, the source of supply, amount used, rate per unit, and the ownership of any transformers, meters or other measuring device, and of transmission systems should be ascertained.

As representative of some of the classes of equipment that may be overlooked, the following examples are given:

Receivers and air transmission lines in connection with air compressors. The location where the compressed air is used should be noted and the location of air pipes both inside and in yards should be ascertained so that no omissions will be made.

The settings of boilers, as distinct from the boilers. Stokers, ash handling devices, and economizers in connection with boilers.

Additional overhead shop bracing required because of some special machines.

Cables and chains used with hoisting and conveying machines.

Flasks and patterns.

In describing the shop machines and in substantiating data submitted in regard to them, the requisition number, the invoice number and date, and the voucher number will be of assistance.

Portable machines and small shop tools should generally be considered in accordance with the foregoing outline. The weight of small tools is of special importance as they are often purchased by weight.

POWER-PLANT MACHINERY.

(I. C. C. ACCOUNT No. 45.)

This heading shall include machinery and other apparatus for generating power in power plants used for the operation of trains and cars, or to furnish power, heat, and light for stations, shops or general purposes, including the cost of special foundations and installation.

Power machinery and other apparatus installed in a shop as part of the shop equipment will be classified under shop machinery; and such machinery and apparatus in stations and offices, used solely for station and office purposes, will be classified under "Station and

Office Buildings." All power machinery should be noted however, in such way that it will be properly described and no omissions will result.

Permanent foundations for machinery and other apparatus will be classified with the building but should be noted in connection with each piece of equipment installed thereon so that cross checking will result and no omissions will occur.

Machinery and apparatus classified under this account should be considered substantially in the same manner as is shop machinery in the outline given, to show the factors of information desired and the methods of investigation to be used in connection with that account.

POWER SUBSTATION APPARATUS.

(I. C. C. ACCOUNT No. 46.)

This heading shall include the cost of machinery and other apparatus, including special foundations and installation, for transforming or storing power in power sub-stations used for the operation of trains and cars, and for power, heat, and light for stations, shops, or general use. Such machinery and apparatus shall be classified under "Power-Plant Machinery" when such equipment is contained in a power plant.

Substantially the same factors of information and the same methods of investigation are required in connection with this account as are outlined for use with "Shop Machinery" and with "Power-Plant Machinery."

CONCLUDING REMARKS.

The part of the foregoing that relates to the necessity for a study of its property by the carriers' engineers, preliminary to the inspection that will be made by Government engineers for securing an inventory and data to assist in making a valuation, indicates the

importance of the results that will be attained and the far-reaching effects either of thoroughness, with its benefits or of superficial and unintelligent work, with its negative effects.

The general items, and the special items under the several property accounts, set down to indicate those features that are fit subjects for investigation and study are illustrative of the hidden and obscure quantities of the special features of construction, and of the conditions attendant on and entering into the cost of constructing and maintaining a railroad property, that should be studied and adequately described and presented. The items set down will suggest to the carrier's engineers other items that should be investigated; and in the course of the investigations still others will be uncovered.

Clearness of statement and completeness of detail should be attained in the compiling and the recording of the results of the investigations and study, so that the notes may be readily understood and may be of maximum use and value as an aid to any engineer who may have occasion to use them.

MSH 21304.

END OF
TITLE